AMERICAN MACHINIST

JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 12, No. 28. WEEKLY. | NEW YORK, THURSDAY, JULY 11, 1889. | $2.50 per Annum. SINGLE COPIES 5 CENTS

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Large Band Re-Sawing Machine.

This machine is one of those recently brought out by J. A. Fay & Co., Cincinnati, Ohio, and now being exhibited in operation at the Paris Exposition.

It is a combination of a re-saw and band saw designed both for re-sawing and plain band saw purposes. It is adapted for reducing deals to lumber, or re-sawing boards to thinner stuff, for panels, picture-backing, etc., also for splitting veneered panels. It will saw through lumber 26″ in width, and to the center of 12″, down to the very thinnest material that admits of re-splitting. The saw used on this machine is only 20 gauge, producing a saw kerf of less than 1-16″ so that, for economy in the saving of lumber, the machine is particularly valuable.

The framing of the machine is massive, and made in cored section, to secure stiffness and strength. Its large base insures a good floor support, and admits of a high rate of speed without vibration.

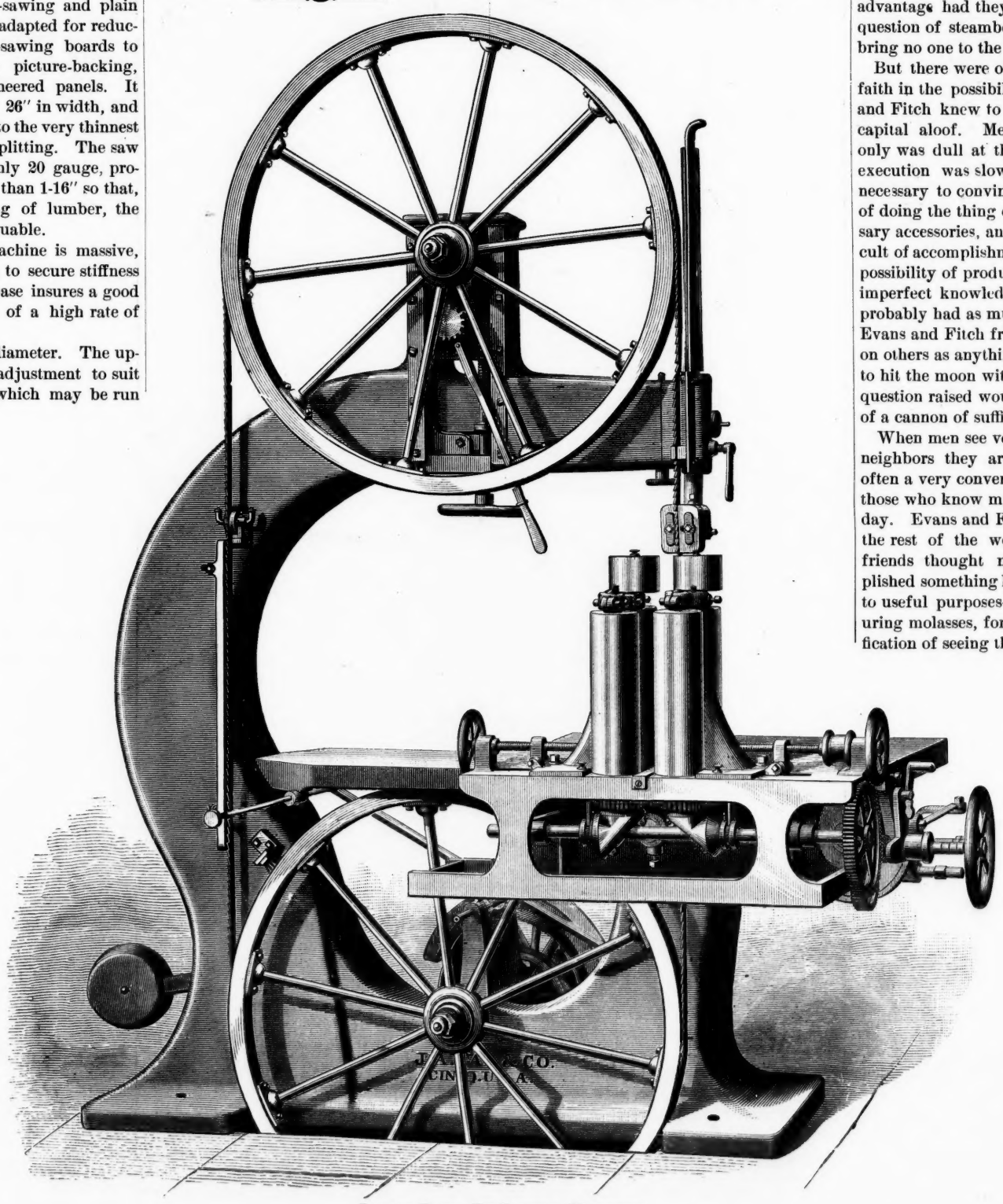
The wheels are 48″ in diameter. The upper wheel has a vertical adjustment to suit saws of different lengths, which may be run on any part of its face; also, a superior weighting device for retaining the saw at its proper tension.

It has patent anti-friction guides, which are provided with steel rollers at the back to receive the thrust of the saw, and laterally adjusting side guides to take up the wear, and to suit saws of different widths. The upper guide, with its supporting bar, is counterbalanced by means of a retracting spring.

The feed works consist of four heavy feed rollers, all driven, both sides being adjustable to or from each other, or at different angles for bevel sawing. One pair of the rollers is made yielding, to allow for inequalities in the lumber being sawed, and to give the necessary pressure. The speed of the feed is graduated by a face friction, which will remain in any position, or it can be moved without stopping the machine to feed the lumber at different speeds, varying from five to forty feet per minute.

The table is made duplex in form, with faces upon its upper and lower side. That portion in front of the saw, and carrying the feed works, is so mounted that by turning a hand-wheel it can be instantly reversed, and thus presents a clear, unobstructed table for any kind of band-sawing. The two tables are divided on a line just in front of the saw-blade, thus avoiding the necessity and expense of separate or supplemental tables.

All the working parts of the machine for making the various adjustments, regulating feed, position of feeding rolls, starting and stopping, etc., are convenient and handy to the operator. The tight and loose pulleys are 20″x6″, and should make 450 revolutions per minute.



Large Band Re-Sawing Machine.

Though nothing definite has yet, we believe, been done in the matter, there is considerable talk of holding an exhibition of some kind in New York City during the summer of 1892, to commemorate the four-hundredth anniversary of the discovery of this country by Christopher Columbus. That was an important event for this country and for the rest of the world as well, and we hope the exhibition will be held, and that it will be a creditable one.

Steamboats and Steamships—Past and Present.

(Editorial Correspondence.)

More than three-quarters of a century ago, Evans and Fitch, two bright American mechanics, were, each in a different way, trying to enlist men of means in the problem of propelling vessels through water by the aid of steam. Their success in this, however, was not equal to their mechanical skill, and they unsuccessfully—as was the custom of the day—sought assistance from State legislatures to further their projects. Both Evans and Fitch had so far shown the practicability of steam navigation, that, had it been the year 1889, instead of nearly a century earlier, they would have found little difficulty in getting capital to push their inventions and—take the greater part of the accruing profits. But, though they did not succeed, the seed they sowed bore fruit for others; unfortunately for them, as for many another poor inventor, it would have been to their pecuniary advantage had they never meddled with the question of steamboats, in which they could bring no one to the point of faith.

But there were other reasons than lack of faith in the possibility of doing what Evans and Fitch knew to be practicable, that kept capital aloof. Mechanical conception not only was dull at their time, but mechanical execution was slow and uncertain. It was necessary to convince men of the possibility of doing the thing conceived, with the necessary accessories, and, what was equally difficult of accomplishment, convince them of the possibility of producing the accessories. The imperfect knowledge of mechanical matters probably had as much to do with preventing Evans and Fitch from impressing their views on others as anything else. If one proposed to hit the moon with a cannon ball, the first question raised would be on the construction of a cannon of sufficient range.

When men see very far in advance of their neighbors they are called cranks, which is often a very convenient way of disposing of those who know more than is current in their day. Evans and Fitch did see in advance of the rest of the world. So Evans, who his friends thought might really have accomplished something had he turned his thoughts to useful purposes—raising turnips or measuring molasses, for example—had the mortification of seeing the conception of his genius remain unused, while Fitch, made insane by his inability to convince others that he knew something, committed suicide.

But far in advance of the vision of others as was that of these pioneers in steam navigation, they never could have seen, by the eye of faith, what it was to come to in three-quarters of a century. Perhaps the present generation, with the past spread out before it, see scarcely more what the future is to be. A small part of the money that it costs to build a modern steamship would have seemed ample to either Evans or Fitch to put in practice what he knew of steam navigation; but they would have built on and up as others have done since, just as fast as correlative knowledge came into existence, and no faster. No one a hundred years ago would have known what to do with a modern steamship had it been miraculously brought into existence; no one could have constructed one had its conception by any mind of the day been possible—so much do certain things in this world depend upon certain other things with which the connection is not always apparent. The construction of

the steamship of to-day is possible because so many other things have been *thought out* during the past hundred years. The efforts of the men who have devised the tools that make modern construction possible appear in the steamship as much as if they had built part of it, and a world of skilled mechanics, who never worked at anything directly connected with steamship construction, are largely responsible for its existence. So in mechanical work as in science, one man, unwittingly it may be, helps another, and this makes the achievements of either or both possible.

After Evans and Fitch, Fulton met with better success, both from the legislature of New York and through the advancement of capital. He fixed the probable limit of speed at eight or nine miles per hour; and later still, when Stevens' boat attained, up the Hudson, a speed of 13½ miles per hour, it was thought the limit must have been reached.

Small as these achievements appear to us to-day, if we consider what those who first made the steamboat a practical success had to work with, what they did was truly wonderful. The builder of to-day has not only all he can desire in the way of tools and material, with an abundance of skilled mechanics to use the one and fashion the other; not only the experience of nearly a hundred years to draw from and lean upon, but he has the faith of others, born of past accomplishment. If he requires tools differing from any now in service they will be devised ready for his use. If he requires material of different form —iron or steel—he has only to make his wants known. All the masterly skill of the mechanician is at his command.

I left New York in the Inman steamship "City of Berlin," hoping, during an absence of a few weeks, to find something to interest the readers of the AMERICAN MACHINIST. I did not expect to see much on a steamship, but watching, at will, the performance of the engines, which I was permitted to do through the courtesy of Chief Engineer William Campbell, the foregoing has come up to me, as, in some form or other, it has doubtless come up to others. It appears to me that there is room for thought in the direction indicated in relation to things other than steamships, or the engines of steamships.

The "City of Berlin" is, as steamships go, classed as small, being only 3,301 tons register. Having been built about fifteen years ago, the sharp contest of the past ten years between steamship companies, each trying to outdo the other in the matter of speed, and in other respects, has resulted in the building of larger and swifter boats, as witness the "City of Paris"—owned by the same company—an account of which appeared in the AMERICAN MACHINIST of May 23. But, on the principle of speaking well of the bridge you have safely crossed, and for other and more tangible reasons, the ship deserves a fair word. She is what would be called a good staunch—I believe that is the term—vessel, not "cranky," by no means swift, but just as sure to "get there" as the faster boats. Though the boat itself is not new, the engines and boilers are nearly so, having been in but about eighteen months.

The main engine is triple expansion, with cylinders 41″, 65″ and 101″ diameter, and the pistons have a stroke of 5 feet 6 inches. The cranks swing around at 65 to 67 revolutions, which last figure gives a piston speed of 737 feet per minute. The engine runs remarkably smooth at this speed, making less noise getting over the centers than I have frequently heard from a tug-boat engine with a 20″ cylinder. The ordinary link motion is employed on all the cylinders, and there is combined steam and hydraulic reverse; also hydraulic hand reverse, which can be used in case of failure of the steam reverse, or for shifting the links to vary the cut-off.

The valves of the high-pressure and intermediate cylinders are of the piston type, while that of the low-pressure cylinder is a flat, double-ported slide, its weight and that of the connections being held up by a balancing cylinder. The eccentrics are on the crank-shaft couplings—an arrangement which permits the use of a shorter shaft.

An excellent arrangement of oil cups is provided for automatically oiling the crank and crosshead pins. For the crank-pins the usual tube leads down, and the oil cup is so arranged that just at the termination of the up-stroke of the crosshead it strikes a buffer, and raises a valve at the bottom of the cup. This permits the escape of a small quantity of oil, which is suitably conducted to the pipe, and finds its way in a regular flow to the pin. Adjustment can be instantly made to provide for the escape of a greater or lesser quantity of oil at each revolution of the engine. These cups, which are of English make, work at about perfection, and are commended by all the engineers on board.

Usually the waste oil from the crank-pits finds its way into the bilge, where it is a nuisance. But on this engine, a recent application overcomes this, and turns the waste oil to a useful purpose. A small pump removes the oil from the crank-pits as fast as it accumulates, and forces it to the stern bearing, where it is delivered at the far end of the stuffing-box. This lubricates that bearing very completely, oil being forced out through the packing, so that it can be seen and felt. This removes the oil from where it is not wanted, and makes it perform the useful work of helping to overcome friction, and reduce the wear of shaft and bearing.

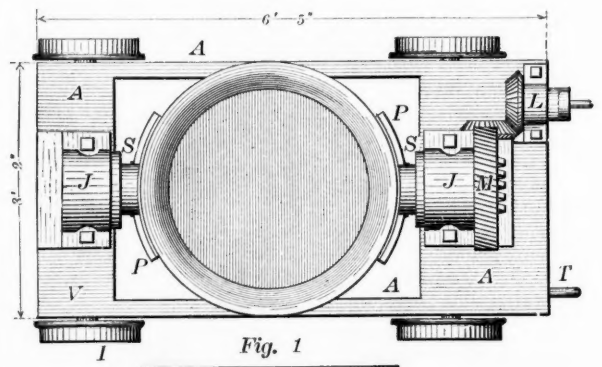


Fig. 1

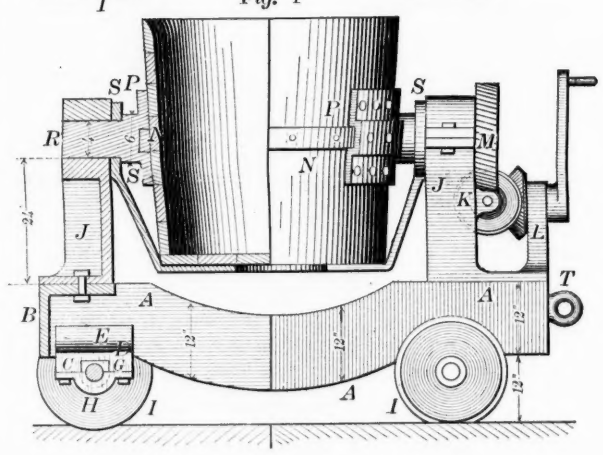


Fig. 2

FOUNDRY LADLE.—SEE PAGE 3.

All the piston and valve rods are packed with United States Metallic Packing Company's packing, and they are as tight—to use the common expression for absolute tightness—as a bottle. Engineer Campbell gives this packing great praise; he says it requires no looking after, and is always tight—it takes care of itself, so to speak. Watching this engine turn over will satisfy any one of the utility if not the necessity of some compensating feature in the packing to provide for a slight movement out of line of the piston rod. Consider the distance between the slides for a cylinder more than eight feet in diameter, and it will be seen that if the crosshead is just free when the engine is running regularly, it will, owing to the unchanging law of contraction and expansion, be almost immovably tight when the slides and frame are cold; hence, at the first revolution made, cutting, if nothing worse, is certain to result. The crosshead must be a little loose in the slides when the engine is heated, as it is when in operation, and the shifting of the rod—which the construction of the packing freely permits—can be plainly seen at each revolution. The engines were built by Laird Brothers, of the Birkenhead Iron Works, and they are a very creditable piece of workmanship. The firm's plate in the engine-room bears the number 820, so I take that to be the number of vessels of one kind and another in which they had placed engines up to the time this engine was built.

There are eight steel boilers, each 13 feet 2½ inches mean inside diameter, and 11 feet 4½ inches in length; shell sheets 1⅛ inch thick. There are three Fox corrugated furnaces in each boiler, 8 feet in length, and 3 feet diameter inside the corrugations; metal one-half inch thick. The grate bars are 5 feet 6 inches long, and the total grate surface of the eight boilers is 330 feet. There are 260 tubes in each boiler, 2¾ inches diameter, and 8 feet 2¾ inches long, and these, with the stay tubes—340 in number—and other surface, give a total heating surface for all the boilers of 14,616 square feet. The water in the boilers, when ready for firing, weighs about 145 tons, and there is a total steam space of 3,142 cubic feet.

The draft is forced by means of fan blowers, which give a pressure of about 4½ inches of water; the pressure in the closed ash-pit is equal to about one inch of water. The air, before coming to the furnaces, is forced through tubes in the up-take, where it is heated to a temperature of 200° Fahr., then it goes to the ash-pit and above the fire.

In addition to the main boilers there are two donkey boilers which furnish steam for the various purposes for which it is required; these boilers furnish steam for some of the auxiliary power, though steam for the auxiliary engines and the pumps comes principally from the main boilers.

Steering is, of course, done by steam, a pair of engines, I should judge about 8″x12″, being employed for that purpose. To those who have seen a rudder handled by three or four men at the wheel, the sailor who watches the compass and guides the course of a steamship of to-day appears as a gentleman of leisure. On the "City of Berlin" he toys with a little wheel about as large as the wheel of a country wheelbarrow, which indicates what he wants done, and the engines do it. Chains from a double drum on the steering engines are suitably connected to a turn-table, and the rudder is moved according to the direction in which the engines turn. Going into the steering engine room, and noting the double-wheel—immense by comparison—provided for hand-use in case of accident to the steam apparatus, sets one thinking what steam has done for the "bold mariner." It may have knocked some of the poetry out of the old-time methods, but it is mighty handy just the same.

There are in a modern steamship a bewilderment of auxiliary engines and pumps. In the "City of Berlin" there are four large fans—I should say seven feet in diameter—each driven by its own engine. These fans, running at 350 to 450 revolutions, require considerable steam to keep them moving. Then there are dynamo engines, an engine for operating refrigerating apparatus, steam feed pump—Worthington compound—bilge pump, circulating pumps, service pump, fire pump—pumps hard to recall the use of—all driven by direct steam, principally from the main boilers, calling on the coal pile for coal, and taxing the men who shovel it into the greedy furnaces, that always want more. Nearly all the pumps are Worthington.

When a quick passage is made—the record broken is the way the daily press puts it—by one of the ocean racers, no one thinks of looking below decks for any part of the cause. The ordinary passenger has a rather confused idea that somewhere below him is something that pushes the vessel along, but, for all he knows, that something "goes itself," so he passes resolutions thanking the captain, and the newspapers laud his skill, and the company pats him on the back. Sometimes the technical press ventures a remark to the effect that the chief engineer has something to do with the matter, but it is never received with any great amount of favor. On shipboard his uniform is likely to be soiled, and then he is apt to be found near his engines, where the least variation in their rhythmical breathing, or a false note in the music they perform, will catch his ear as quickly as the musician will detect a discord. Many a breakdown has been prevented, or stoppage avoided, through the instrumentality of the ear of the chief engineer of a steamship, or that of his trained assistants. The little premonitory squeak is no sooner emitted than its cause is the subject of investigation, and that which might have gone wrong for the lack of a little oil, goes right by virtue of it. Skilled men working daily within hearing of these great engines come to understand their language about as well as they do the language of the human voice. When the engine is going right it says so, and when going wrong its warning is plain to the trained ear. But it takes time and hard work to learn the language of the ponderous machine, in which the consequences of a breakdown are always serious.

When the vessel arrives at her port the work begins, and continues to the end of the next voyage; in the instance of steamships sailing as frequently as most of the trans-Atlantic steamers, there is little time for rest in the engineer's department. The "City of Berlin" remains in port about four days. During that time boilers must be opened, examined and cleaned, tubes and passages cleaned, the main engine must be carefully examined, lost motion adjusted, one of the pistons and its valve examined—(the covers are removed and one piston, and its valve, each in turn, are carefully examined at the conclusion of each voyage)—all the other engines and pumps put in order, and such repairs as are required must be made. This, with the general cleaning up that must be gone through with, keeps the sixty men under Engineer Campbell busy, frequently day and night. The pieces of the main engine, it will be remembered, are not of the weight of the corresponding pieces of a 200 horse-power stationary engine, and the adjustment must be made with the greatest care and skill. It is not as convenient to stop for readjustment at sea as it is to stop a land engine; and time is lost in stopping. Then causes of possible accident must be sought out, and provision made for their avoidance. The pride of the chief engineer of a steamship is in making his run without delay or accident, and to come into port with his engines turning over smoothly; hence his careful supervision is over all repairs and adjustments. The responsibility of his position can hardly be over-estimated. He must be a first-class mechanic, and possess other qualifications that few have.

At sea there is no relaxation of care on his part. The position calls for eternal vigilance, but it is hardly rewarded with liberty. The consumption of coal must be kept down, and the speed must be kept up. This requires careful firing, which must be looked after; for the ordinary fireman, working in an atmosphere none the best, and under a temperature of 130° Fahr., cannot be expected to exercise more than the minimum amount of judgment. But steam must be kept up, for a falling off in that means fewer turns and less speed. Fans must be kept going, pumps must perform properly, auxiliary engines do their duty, the main engine must be indicated, and that supervision that prevents trouble must be unceasing. Those who think the chief engineer of a transAtlantic steamship, or his assistants, have a sinecure will very soon acknowledge their mistake if they will put themselves in the way of seeing what these men do before and during a voyage. They are the men who make fast runs possible; the men who break the record when it is broken. All of them must be skilled mechanics, and must be competent, able men. Give them some of the praise that is due them. The captain deserves a

great deal, especially if all captains are like Captain Lewis, of the "City of Berlin," whose efforts towards the comfort and pleasure of his passengers are unlimited, and whose seamanship and ability are unquestionable.

But incessant care cannot prevent the machinery of a steamship from breaking down at sea. It will sometimes let go without warning, then the mechanical skill and ingenuity of the engineer is of special service. On a recent voyage the piston valve of the high-pressure cylinder of the "City of Berlin" broke. The valve was disconnected and removed, but pieces of the packing were missing, and as these might get into the ports of the intermediate cylinder, and disable its valve, they were searched for, and finally so far collected that it was thought safe to proceed. The high-pressure piston was not removed or disconnected, the steam passing through this cylinder to the valve casing of the intermediate cylinder, the engine working the remainder of the voyage as a two-cylinder compound, and under reduced steam pressure. In a short time after the accident the ship was steaming along at fifty-four turns of the shaft, dragging the high-pressure piston—now useless for the time—through its usual journey back and forth.

Many are the instances in which the engines of a steamship have, apparently, been quite disabled at sea, but the engineer has contrived to bring her in under steam. In triple expansion engines, if the shaft holds together, it is generally possible to work two, or at least one of the cylinders.

I have had occasion to speak frequently of Chief Engineer Campbell, whom I found as courteous as a gentleman as he is able as an engineer. I am indebted to him for every opportunity for observation, and for any information asked for. He is a veteran in the business, having been with the Inman Company more than thirty years—and his first work was not with that company. In going around with him amongst the machinery, it appeared to me that his eye missed nothing, and a quiet hint here and there called more than one man's attention to some trifling matter that required attention. The way in which the machinery of the "City of Berlin" does its work is all any one acquainted with mechanical matters would care to know about his ability as an engineer. In the voyage from New York to Liverpool his engine made about 800,000 revolutions, and the last thousand were made just as quietly as the first.

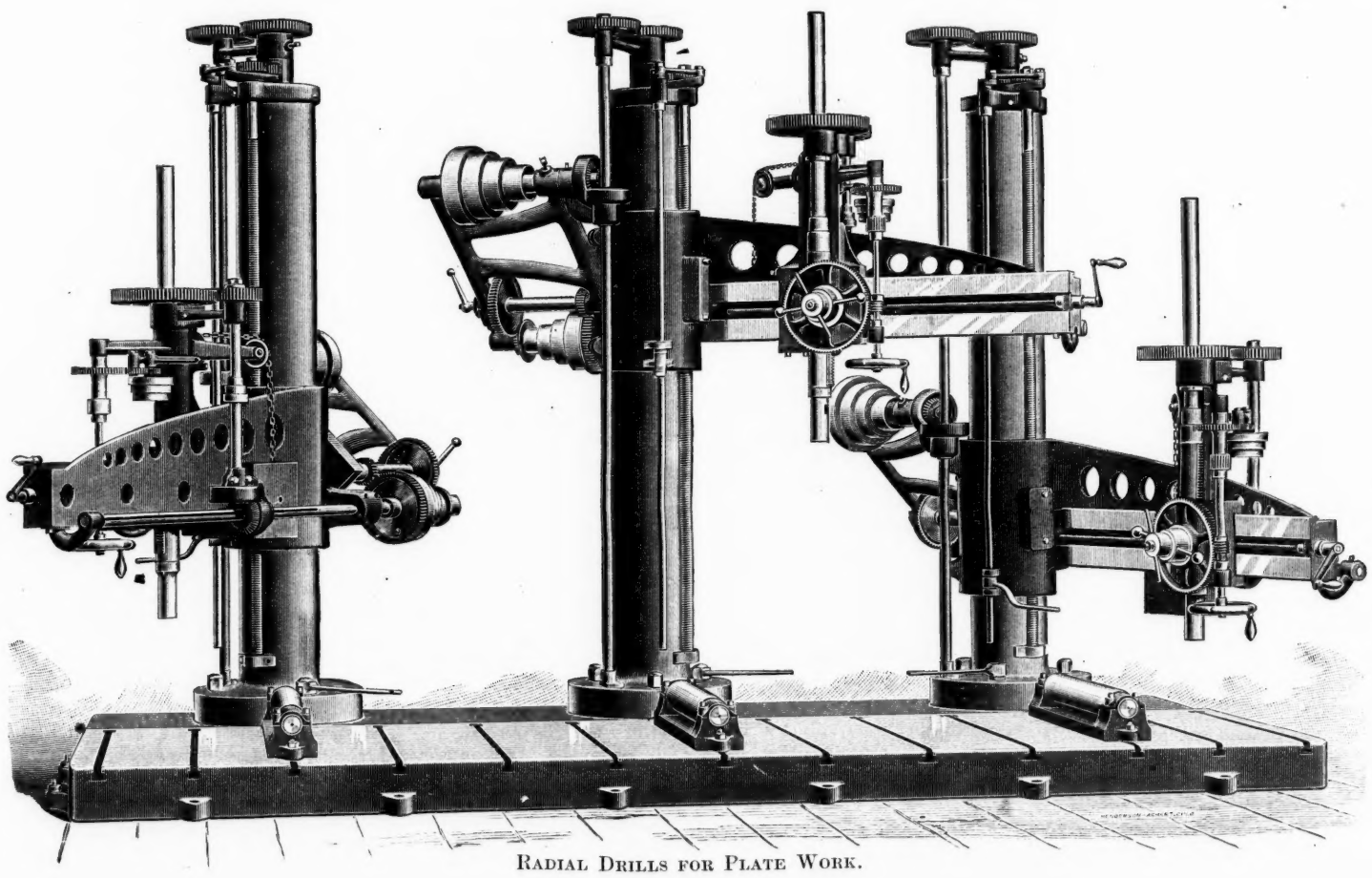
I have spoken of the present engine being nearly new. It replaced a two-cylinder compound, which required four more boilers than are now used. But there is no ground for comparison here, since the new boilers carry higher steam pressure, which is a potent factor in economy of fuel. The present boilers are licensed in New York for 150 lbs. pressure, and they generally get it. The old ones carried, I believe, 80 lbs., so it is not possible to say how much of the saving in boiler capacity is due to triple expansion, and how much to high steam pressure. Perhaps triple expansion would have been no advantage with the lower pressure, and two-cylinder compound might have been at a disadvantage with the higher pressure, although this is not probable.

The engine usually indicates, under regular working conditions, from 5,500 to 5,700 horse-power—but is capable of doing 7,000 horse-power. Making an allowance that appears to be about right for the coal required for pumps and auxiliary engines—1½ lb. of coal per I. H. P. per hour is required with greater boiler capacity, so as to permit easier firing—the consumption of coal would undoubtedly be reduced.

The cut-off is at about 3 feet 6 inches in the high-pressure cylinder, some 4 inches later in the intermediate, and 4 inches later in the low-pressure cylinder than in the intermediate.

About 30 lbs. of coal are burned per hour per square foot of grate, giving about 17 horse-power; a little more than three knots are made for each ton of coal burned. Keeping within the limits of easy fractions, it takes $2\frac{4}{10}$ lbs. of coal to give one revolution to the shaft—each revolution advancing the ship on her journey nearly 20 feet.

H.



RADIAL DRILLS FOR PLATE WORK.

Foundry Ladle and Carriage.

BY ROBERT E. MASTERS.

Fig. 1 (page 2) is a plan view of a large ladle and carriage. There are two views at Fig. 2; the right-hand half of the drawing is a side elevation, and the left hand portion is a sectional view through the center of ladle and carriage.

The bed-plate or frame *A A*, in Figs. 1 and 2, is cast in one piece; it is 6′ 5″ long, 3′ 2″ wide, 12″ deep at the sides and ends, and 1½″ thick. *B* shows the shape of the ends of the frame. The axle-boxes *C* are cast on the frame wide enough for a good bearing, and from the top of the box *D* they taper off to the thickness of the side of the frame at *E*. *G* is the journal brass, and the dotted line *H* shows the oil cellar. The axles are 2¾″ round iron. *I I* are single plate chilled car wheels, 20″ diameter and 4″ face, gauge 3′ 7½″.

The uprights *J J* to support the ladle are 24″ high from carriage frame to bottom of bearing, and taper from 18″ wide at base to 11″ at the top; they are box shape and 1¼″ thick. The front standard has bearings on it for the worm and pinion shaft *K*. The crank shaft standard *L* is cast in one solid piece, and bored through the end for the wrought end of the crank to go through to key the miter pinion on; the standard is bolted to the bed, and is 11″ high, to the center of bearing. The 24″ gear *M* is keyed on the end of the ladle trunnion.

The band *N* around the ladle is 4″ wide by 1½″ thick; over this the trunnion plates *P* fit. These plates are 17″ wide, 17″ long and 1½″ thick. The trunnions *R* are 6″ diameter at plate, and 4″ diameter in bearings; plates and trunnions in one piece.

The wrought-iron strap to support the bottom of ladle is 2″ wide and 1¼″ thick in the rings *S S* where it fits around trunnions, and 3″ wide by 1″ thick at the sides, and forming an oval underneath the ladle.

The ladle is made of ⅜″ iron. The inside dimensions of shell are: Bottom diameter, 44½″; top diameter, 50¼″; height, 50¼″. Lined up with fire-brick and clay, 3½″ thick in the bottom, and 2½″ at the sides; this ladle will hold 16,000 pounds, and leave 3″ room from the iron to the edge of the ladle, this for the sway and motion of the iron, and for safety.

T is a wrought-iron eye-bolt in front of carriage; there is also an eye-bolt fastened to the carriage at *V*, extending clear over the wheels. A chain fastened into the eye-bolt *V* goes through a chain sheave that is fastened back at the cupola; the chain then extends to and around drums in a stationary frame that are at the opposite side of the shop, and then continues, and is fastened to the eye-bolt *T*. The ladle is hauled back and forth across the shop by a power rigging at the drum, on the same plan as is used to operate a planer bed.

This ladle is used in a car wheel foundry, and receives the iron from a large Colliau cupola, and is kept as near full as possible during the whole heat. The wheel floors are straight, and have overhead tracks and traveling cranes. The ladle is hauled on the track which crosses the foundry at the end of the wheel floors, the wheel ladles are filled from it, and the large ladle hauled back under the cupola spout. A few open links are kept handy in case the chain breaks. The carriage moves at a very good speed, and does not pull as heavy as one would think; I have seen four men pull the ladle across the shop when it was full, by giving it a little start with a pinch bar.

Of course it would be unfair to presume that the *Manufacturers' Gazette* of Boston has no one on its editorial staff who knows anything of mechanics or engineering matters; but it is quite evident that the engineering editor must have been absent recently, for a time at least, the evidence of this appearing in an editorial article, in the issue of June 22, commenting upon the new steam storage scheme to which we alluded last week. This editorial resembles very much those relating to mechanical matters often found in the daily newspapers, and, it is apparent, was written by some one having a very sad lack of familiarity with the subjects about which he was writing. He seems to assume that steam has, until recently, been in great danger of being superseded by electricity, because, until electricity appeared, steam "had no rival, no competitor, and on this account has not, according to many authorities, advanced in the line of perfection in the same proportion that other branches of science, pushed by competitors to more economical and improved methods, have done." Now that electricity has so nearly driven steam out of use, the steam men have at last been roused from their lethargy, and the result is steam storage, with which electricity cannot hope to compete, provided cheap fuel can be obtained. All this is, of course, absurd, and only serves to emphasize the necessity for constantly keeping some one around the office of a journal circulating among manufacturers who knows something of engineering, or else carefully steering clear of such subjects.

Radial Drills for Plate Work.

With this we present an illustration showing an arrangement of radial drills specially adapted to heavy plate work, this machine having been built by the Cincinnati Universal Drill Co., for the Portsmouth, Va., Navy Yard. The drills themselves, having been recently described in our columns, need no description at this time. They are attached to the heavy bed plate by means of rigidly attached stumps over which the columns fit, and are so placed that any part of a sheet may be reached by one or more spindles, and all three may be in operation simultaneously.

The rollers, one of which is shown in front of each column, are intended to facilitate the handling of heavy sheets or beams, and may be placed in any desired position on the bed, or readily removed altogether.

Separate countershafts are furnished for each machine, so that the movements of each are entirely independent of the others. Though intended primarily for plate work, it is obvious that the arrangement may be used for other forms of heavy work where it is desirable to drill several holes simultaneously.

It seems to be the general verdict of visitors to the Paris Exposition that America has not made very good use of her opportunities, so far as securing a creditable general display is concerned, but that our machinery interests are best represented. It is also declared that the credit for much of the machinery exhibited by other countries belongs to America.

Practical Details of Blacksmithing.

BY B. F. SPALDING.

THE COMMON ANVIL—SOLIDITY AND ELASTICITY—USE OF THE BICK—INERTIA OF THE HORN—ARCHED ANVILS—CAST ANVILS—UTILITY OF A CENTER HOLE—THE SQUARE HOLE—THE FLAT HORN FACE.

The form of the wrought-iron anvil at present in vogue appears to be as well adapted to its purpose as any that can be devised. Let us examine into its fitness for its uses.

The center part, where the greatest amount of hammering is to be done, is made solid from face to base. It is intended that mass shall be aggregated here to the full extent of the weight allowed to the anvil, because it is this part that is to furnish much of the inertia, which has by some been considered so essentially a prime qualification for this tool, that it has acquired the name of the anvil principle, and is often so called when its properties are spoken of as used or required in mechanical constructions.

But there is no *kick* in absolute inertia; there is as much inertia in a bag of sand as there is in a mass of iron of the same weight, and as the bag of sand does not manifest any quality which the anvil principle is wanted for, it is easily perceived that inertia is not all that is required; that the true principle in question is not only an indisposition to move from a position, a reaction against action; and it is very plain that not only for its inertia, but also, and in a greater degree, for its quick acting and ready resilience, that the solid mass of iron extends from the face to the base of the anvil. This is a living and active, always antagonistic principle, and to be brought to manifest its perfect condition in an anvil, the direct lines in which the force of the blow which is struck upon it will act must be so long that its force, spending itself diffusively over the oblique diverging lines, is overpowered by the force of resilience, which concentrates rapidly from all directions, and immediately returns the full force of the blow from the point of impact. The anvil must be so deep as to rebound the full force of the blow, and transmit none to the block below. Then the full force of the blow will be saved and expended on the work, but whatever amount of the blow passes through the anvil to the block is lost, so far as its intended purpose is concerned.

An addition is made to this solid mass on one side, which is called the beak or bick; it is flat on the upper side, and the flat face of the anvil is extended over this. The primary object of the beak is to afford as solid a place as circumstances will permit for hammering on anything which has some projection on it which will not permit the part which is to be worked upon to come on to the middle of the face of the anvil, because it will be obstructed by the body, but which will pass under the beak, and let the part which is to be hammered be supported by that.

The beak is very strongly braced by its form, but not as strongly as it would be, if, instead of being of a concave form on the lower side all the way from the lowest point at which it joins the mass, it changed the concave to a convex form soon after leaving the body, and continued this convexity to the end, as shown by the dotted lines in Fig. 1. But as the concave form has the practical advantage of greater facility for working forked pieces, which are narrower in their opening than could be got on the convex form, this advantage is conceded to more than counterbalance that of the superior stiffness which would be given by the other form. The present shape is, for general purposes, undoubtedly the best.

When a piece of iron is laid on the beak, and blows are struck upon it, they do not seem to impress it as much as they do when it is laid on the solid part, and it will appear that the nearer the work comes to being laid over the solid part, the more does it feel the effect of the blows. If it is laid at the end of the face opposite to the beak, that is, close to where the off set for the horn is made, it is a little beyond the place where the perpendicular lines of percussive force will go through solid metal to the base, as from this point they would strike on the arch of the concave below; but nevertheless, every blacksmith has a kind of intuitive perception, that blows struck with any ordinary sized sledge upon iron laid on this place, produce as much effect as they do when it is laid in any position whatever on the anvil, and it will be noticed that, when the horn is broken off, this place does not seem nearly so solid as before. It is true that the part that is gone had no support except from the body which still remains; it only stuck out into the air, but even thus, as a mere dependence upon the anvil, it was yet by force of a principle a support to this part of the anvil. This principle is the same as that which the blacksmith relies on for the support of one end of a bar of iron which he desires to break at a distance from that end; he cuts around the bar with his cold chisel, and then shoves it along until the cut place is beyond the anvil, and the sledgeman strikes it on the cut, causing a sudden downward tendency at that point, but also a contrary upward movement of the out-lying end of the bar; the desired result of this conflict of contrary tendencies comes when the bar breaks.

At the first glance, it looks as though the blow being downward, there would be no tendency in any part of the bar to rise, but everywhere simply a reluctance to fall; but as we trace the effect of the blow along the whole extent of the bar, we find that its downward tendency started at the cut, and moved along towards the end, and as it went, it was resisted with more and more potence

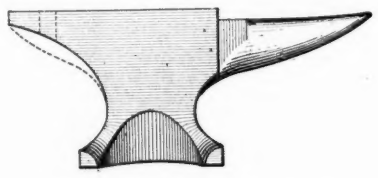


Fig. 1 The Common Anvil

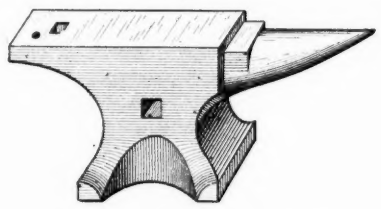


Fig. 2 A Center-hole Anvil

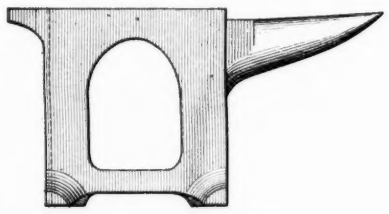


Fig. 3 An Arch Anvil

Fig. 4

by inertia, until it had traversed about two-thirds the distance, and from and beyond this point as a fulcrum, the end of the bar had a tendency to rise, being lifted as the resisting part of a lever of the first kind, pried up over the invisible, but still plainly palpable fulcrum of inertia by the quick force of the blow, which gave a downward motion to that portion of the bar nearest to the anvil. It is this principle which makes the horn contribute to the solidity of the anvil. If the end of the horn were not made small, if it was continued of the same diameter as at the largest place, the anvil would soon part company with it, for the tendency to contrary movement of so great weight would break it off; but being tapered off as it is, the center of motion due to the blow is very near the largest part of it; the inertia is thus practically distributed throughout, concentrating, however, at the jointure, and moving the center of percussion of the whole anvil to that side of the center of gravity where, as before remarked, every blacksmith knows that the anvil feels the most solid.

Some large cast anvils, designed for heavy work, where much execution is needed to be done over a part of the anvil which will admit a part of the work to pass under it, are so made that the thin part of the anvil is in the center, being constructed on the arch principle, the pillars of which, being the ends of the anvil, go down and unite with the solid base. In this manner a resistance is secured as firm as may be desired. Such an anvil, of the same weight as that shown in Fig. 1, is illustrated by Fig. 3.

There may be something of this kind in the future for the common anvil, when the art of steel making is sufficiently advanced to cast them of a quality of steel that will meet the requirements of toughness, hardness and cheapness; but, as things go, it would be too expensive to make anvils of wrought-iron of this form.

It might not be advisable to make such anvils entirely of highly carbonized steel, but substituting pneumatically refined iron for the best gun iron now used, or reducing wrought-iron to a fluid state by the Mitis process, they might be made on the Fisher plan, which has produced excellent anvils, by the process of welding the faces on in the mould; by pouring the molten metal on them until they have become sufficiently heated to flux on the side submitted to the burning to such a degree as to enable the metals to thoroughly coalesce.

The adoption of some such method might secure—if it was thought advisable—a well-wrought, thoroughly hammered and dense face, high in carbon, and by innate nature hard. There is this to be taken into consideration, that if it was not in its natural temper hard enough for the purpose which the anvil was to be used for, it would be subject to the strain and risk of undergoing an artificial hardening process, and its shape would make this a severe ordeal to pass through. This shape has such variations in the thickness of material, that it would be a very difficult matter to cool it uniformly over the center and extremes of the arch, and the whole being rigidly bound by the connection at the base, they would be greatly stressed in and by their unequal expansion and contraction.

When a comparison is instituted between the distribution of the material in this and in the common anvil, the point is easily made clear that the common anvil is in better shape to withstand these unavoidable strains of hardening than any form that can be imagined, which has to be of such unequal thickness; for the thin parts, the beak and horn, are at liberty to warp as they will, being entirely free at one end.

With regard to the horn, if it is made hot and suddenly cooled, it is subjected to the same strains of uneven contraction, whether it is faced with a hardening steel or not. If sudden cooling makes it brittle, it is only less able to bear them. The fact is not altered, that it is equally subjected to the strain, however its hardness may be affected. Its shape happens to be peculiarly favorable to taking it without injury.

A hole $1\frac{1}{2}''$ square through the anvil from front to back, about in the center (see Fig. 2), would be very convenient sometimes for holding tools, such, for instance, as a small horn for welding tapering ferrules or small bands, or a beak on which to do such work as hammering down the ends of small forked wrenches, or it would quite often come in play for running a bar of iron or steel through for breaking off short pieces; but, although all will acknowledge that it would be convenient for a thousand things, yet they do not consider it of sufficient practical value to go to the trouble of making the hole. Probably, if the choice was offered between one with such a hole and one without it, most blacksmiths would take the one that had it, if the price was the same, but would not be willing to pay much for the advantage. They have always got along without it, and will probably continue to do so. The hole in the beak (see the face of the anvil in Fig. 2) answers very well for all purposes. It will hold cutters, swages, fullers and forging dies by their shanks if they are well fitted in a firm and substantial manner. It is handy to bend or break iron over, to hold heading tools over, and to punch holes over. Its presence gives, in the simplest and most direct manner possible, all the combination qualities which are requisite. Into it can go contrivances equivalent to tire shrinker, vise, shears, drill press, or most anything else which ingenuity would attach to the embodiment of solidity. If this hole were not in the anvil, the resources of the blacksmith in the way of tools would be greatly curtailed, and many things which he can now do easily for his customers would cost them a great deal more than the present modest charges. A hole is nothing, but it may be queried whether that insignificant hole in the anvil has not been of more material worth to the world than the invention of movable type; and yet, who ever thought of wondering who punched it first?

The small round hole (see Fig 2) is a very important thing to have in an anvil also, although not by any means as essential as the square one. It will hold small tools if occasion requires, and is very convenient to punch small holes over. This was perhaps its primary purpose. If it is straight, smooth and perpendicular to the face, it answers for a heading tool. Over it, small heading tools for nails have a good support. It may be squared out This has been done in some instances as an improvement in its form for holding small tools to keep them from turning around. If squared, with the sides coinciding with those of the anvil, it gives weakness to the corner of the anvil beyond it, and if diagonal to these there is some more trouble in fitting tools to it. It is so near the edge of the anvil that there is little trouble in making lips to fall over the edge of the anvil to keep steady in their place the few tools it is generally desirable to have in this hole. Fig. 4 shows a hardy for nipping drills made in this manner. The fact that tools of this description are so seldom made—scarcely a blacksmith has more than two or three—shows that the hole in the place and form as it is now made is very nearly what it should be, and that, as far as is apparent in these respects, no change can be made that will be likely to meet with general acceptance.

The off-set from the main face down to the face of the square of the horn gives a square inside corner. The horn is set lower than the face, in order that it may not interfere with anything which may be laid lengthwise on the face to straighten, or work in any other manner. This off-set is as abrupt as it can be made, leaving the end of the face a square outside corner, following a straight line down and terminating at the flat top of the horn in a square inside corner. Sharp inside corners are notoriously weak, and this is made to appear still weaker by decreasing the width at the same line, to make the flat face of the horn considerably narrower than the main face, thus forming also an inside corner on each side. Thus is the opportunity given to the anvil to set constantly before the eye of the blacksmith a good example, to show him how this weakening form in one place can be compensated for in some degree by appropriate reinforcement and corrective proportion in another. These are given in this case by the shape below, which acquires its greatest fullness opposite this place, and does not terminate the outline of the horn at these corners, but continues its curve beyond, lengthening to some extent the short arm of the leverage, and not allowing the vibrations to concentrate so absolutely at this point.

The narrow flat face of the horn adds a very useful feature in furnishing a place to work pieces which are somewhat shorter between two shoulders than will go over the wide face. It is not generally hard, and for this reason is often used to cut hot iron on, the hard steel face dulling the chisel when the too impatient striker drives it too hard through the iron. This is not a good practice, for a better plan is to bend a piece of soft iron, or if very particular, a piece of copper to fit over the square of the horn for this very necessary purpose. It is a good place

to hold a piece of iron when fullering down into a shoulder, letting the back side lay up against the off-set, where it rests more firmly than it does when laid up against a stake set in the square hole, when this operation is performed on the main face. When one attempts to enumerate all the uses which this part of the anvil serves, he finds that they are so many, that a considerable knowledge of the trade would be required to understand them, and the fact that they are so many and various, shows the necessity for its being as it is.

In considering how well the common anvil is adapted to the purposes for which it is made, it has been thought necessary to notice only some of the minor features, which, without some attention, are liable to be passed over without observation. This has been done to show how much their combination with each other adds to the completeness of the whole tool. Nothing specially needs to be said of the face. Its purpose is too plainly obvious. The same is true of the horn. On general work, one of these is as important as the other. Neither of them could be taken away without entirely destroying the value of the anvil, except for use on some special work. Nor does it need more than mere mention to call attention to the admirable manner in which the base is formed to secure extended points of support, without placing impediments in the way of using the working parts.

Taken as a whole, it may be said that the anvil, in its evolution from the flat stone or the iron-headed stake of our ancestors into its present fullness of utility and severity of style, has passed through as many beneficial changes as the sixteen horny-toed, sheep-sized, antediluvian brute, with wolf teeth, that has finally developed into the clean-cut, thoroughbred race-horse, and has, like him, by the addition of essentials, stripped of every shred of superfluity, become, as viewed in our present light, a completed and perfected model of symmetry and efficiency. It is quite probable, however, that, as the character of the smith's work changes, imperfections will be perceived, and improvements continue to be made.

Illustrations of anvils sent forth by anvil manufacturers, very properly show the anvil from the blacksmith's side. The cuts used for this article represent it as the spectator generally sees it from the sledgeman's side. This remark is rendered necessary by the fact, that pictorial sketches, showing the blacksmith at his anvil, cause remarks to be made by the craft, because they almost invariably represent the smith standing on the sledgeman's side of the anvil, a place where he has seldom any business or desire to get. Even cuts put out by steel makers show the anvil with the wrong end towards the forge. This position would bring the blacksmith's right hand over the horn in swedging in a swedge set in the square hole, and would endanger his hand. None but left-handed smiths use the anvil in this position on general work.

Efficiency of Vapor Engines.

BY PROF. DE VOLSON WOOD.

In regard to the discussion growing out of my paper on "Vapor Engines," I wish to present some things in a different light than that given by Professor Denton in the AMERICAN MACHINIST of June 13th. It is not my purpose to review his article, for it needs none, but I cannot bring out more clearly the point I wish to make, than by quoting the substance of one paragraph:

"If the piston displacement *A B*, when filled with ether vapor at 100 pounds pressure, contained as much *weight* of ether as it would of steam, then the efficiency of the ether would be about five times that of steam."

I assume that the writer did not intentionally write this as here printed—that the words "ether" and "steam" should be transposed; for the weight of a cubic foot of ether vapor is about 1.03 pounds at 100 pounds pressure, and of a cubic foot of steam, 0.23 of a pound, making the vapor about 4½ times as heavy as that of steam for the same volume, so that, when the same volume is filled with the respective fluids, there will be some four or five times as much *weight* of the vapor of ether as of steam. The relation is correctly used afterwards.

The fact that the densities of vapors are *inversely* nearly as their latent heats of evaporation at their boiling points under the pressure of one atmosphere is well known.

Admitting that it read correctly, it would contain a physical impossibility. It is impossible to put into a given space the same weight of steam as of the vapor of ether at 100 pounds pressure. I understand that the assumption was merely for the sake of illustration, but it necessitates the further assumption that all other properties remain unchanged.

In my paper, in establishing the general expressions for work and efficiency, I followed the usual mode of finding the work done per *unit of weight*. The density of the fluid was not considered—neither does it enter into the investigation. A pound of fluid, as a medium, will do a given amount of work, and 4½ pounds will do 4½ times as much under the same conditions; but the efficiency will be the same in both cases. The density of the vapor affects the size of the cylinder that is to develop a given power. The volume of a steam cylinder must be more than four times that of an ether cylinder, to contain the same weight of vapor. When the work done per pound of vapor and the density of the vapor are known, the volume of the cylinder may be determined. If, then, the density of the vapor does not enter the analysis, how does it appear that the efficiencies of the several vapors are so nearly the same? Our object in writing is to answer this question, and do it in an approximate way, so as to avoid delicate analysis We desire to show that it is due chiefly to the fact that, if a larger amount of heat is expended in producing the higher pressure in one fluid than in another, a larger amount in that case will be rejected than in the other. To be more specific, steam at the pressure of 100 pounds is at a higher temperature, and contains more thermal units than ammonia, ether or bisulphide of carbon at the same pressure, and if our proposition is correct, the temperature of steam at exhaust will be higher than for any of the others, and it will contain more thermal units, the terminal pressure being that of one atmosphere. The following table shows these relations:

Substance.	Temperatures, Deg. Fahr. at Pressures, lbs. per sq. in. 100	14.7	British Thermal Units in the vapor above the boiling point. Initial.	Terminal
Steam.	328	212	1,002	966
Saturated Ammonia.....	56	—27	612	572
Saturated Ether.....	215	95	206	162
Saturated Carbon Bisulphide	248	115	163	153

Deg. F.

Steam loses .....328 — 212 = 116
Ammonia loses..... 56 + 27 = 83
Ether loses..... .. 215 — 95 = 120
Bisulphide Carbon ....248 — 115 = 133

It will be observed that the temperature of the steam at exhaust, 212, is the highest of these four vapors, and that the initial temperature, 328, is also the highest. The *initial* thermal units of the steam, 1,002, is also the highest, and the thermal units in the steam at *exhaust*, 966, is also the highest. This general law exists with all vapors, and is one of the most influential elements in determining the efficiency, but not the only one.

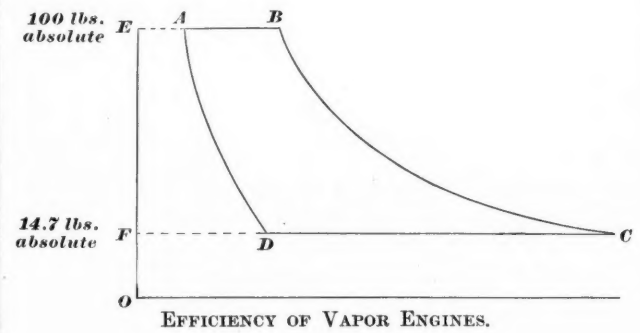
My paper shows that an *approximate* value of the efficiency in these cases is

$$E = \frac{\text{Difference of temperatures}}{\text{Highest temperature added to 460}}.$$

Applying this to the cases above, we have:

Substance.	Difference of temp. Deg. F.	Highest temp. added to 460.	Approximate efficiency E.	Correct theoretical efficiency.
Steam	116	788	0.15	0 16
Ammonia ..	83	516	0.16	0.15
Ether.....	120	675	0.18	0 15
Bis. Carbon	133	708	0.19	0 17

The approximate efficiencies exceed only a little the theoretical ones, and it follows that the controlling elements are difference of temperature, and the initial temperature increased by 460. If the difference of temperatures is small, as for ammonia—83—the higher temperature—56—is so much lower than for steam, that the efficiency is actually higher.



EFFICIENCY OF VAPOR ENGINES.

Messrs. Gantt and Maury in their thesis upon vapor engines, considered a variety of conditions, and worked out in detail all the important results flowing therefrom (*Van Nostrand's Engineering Magazine*, Nov. 1884, p. 413). The following is an abstract of one of their tables, in which the initial pressure was 120 pounds per square inch, and the final 10 pounds. Some of the results for ether are too small, due to their considering the specific heat as negative, like the other vapors, whereas it is positive within the limits used.

SUBSTANCE. Vapor of	Initial Pressure. Lbs. per sq. in. p.	Terminal Pressure. Lbs. per sq. in. p_2.	Initial Temperature. Deg. Fah. T.	Terminal Temperature. Deg. Fah. T_2	Weight of a cubic ft. of the vapor at the temperature T. W_1	Latent heat of evaporation at the temp. T. in British Thermal units, etc. he.	Specific heat of the liquid. c.	Volume of vapor at end of expansion, the initial volume being unity. v_2.	Work done per cubic foot of vapor from temp. T. W.	Total heat in ft. lbs. supplied per cubic foot of vapor. H.	Efficiency of the fluid per cent. 100 W÷H= E.	Relative size of the cylinders to produce the same power from each vapor. M.	Pounds of vapor necessary to produce one horse-power per hour between 120 lbs & 10 lbs. pressure. W.
Water.....	120	10	342	195	0 317	873.1	1.000	9.37	50.289	272,813	18.38	1 000	11 44
Alcohol	130	10	291	157	0.834	313 2	0.871	9.92	54,196	300,000	18 06	1 071	30.48
Ether.....	120	10	230	77	1.400	135 0	0.569	12 06	44,800	324,000	13.85	1 708	80.24
Bi-sulp. of Carbon ...	120	10	266	96	1.399	126.0	0 249	9.00	35,545	179,000	19.75	1 480	78.15
Chloroform	130	10	286	121	2.171	94.7	0.242	10 29	47,609	232,000	20 46	1.264	90 30

A New Locomotive Boiler.

BY W. H. BOOTH.

Departing from all traditional practice, Mr. Webb, the locomotive superintendent of the London & Northwestern Railway, of Crewe, England, has designed an entirely novel fire-box, which seems to possess many points of interest to engineers. While the back end elevation of the Strong boiler has the form somewhat of the figure 8 laid upon its side—thus ∞—the same view of the Webb boiler is that of figure 8 in natural upright position.

Mr. Webb's idea has been brought to a head by the recent high price of copper, the ordinary English material for fire-boxes, and the form of construction chosen has been to enable steel to be employed in a shape which experience in stationary boilers has proved it better able to withstand than when disposed in the shape of steel-stayed flat surfaces illy contrived for withstanding present high pressures.

The place of the ordinary rectangular fire-box is taken by a box of the form indicated in side elevation in Fig. 1 (page 6), and consisting of five sections *a*, *b*, *c*, *d*, *e*, formed of steel plates, united by Adamson flanged seams, this being the second instance of the employment of the Adamson seam in locomotive work, but very probably by no means the last.

Of the five sections, *a* is perfectly cylindrical, and may, of course, if necessary, be corrugated. One end of this cylinder is closed by a plate *g*, which is in one piece with the flange ring of the junction above it of the upper cylinder *d* and combustion chamber *e*. This flat closing plate is stayed against pressure by stud stays to the flat front *l* of the fire-box casing.

The rear lower section *b* is also cylindrical, except where united to the upper chamber *c*. The junction length is flattened, and the flattened waist is studded to the similarly flattened waist of the outer casing.

Sections *a* and *b* form then the furnace proper and contain the grate, and below this the ash-pit, which communicates in front through the plate *l* for cleaning purposes. The waist of the fire-box forms a contracted area opposite the fire-door, at which point the gases from the fuel on the grate are forced to pass and mingle with the air admitted at the door for purposes of complete smokeless combustion. *c* and *d* form the upper part of the fire-box *d*, being perfectly cylindrical. An addition is made by a further chamber *e*, which, though cylindrically formed below, is widened out laterally and flattened above to admit of a larger tube plate *k* than a cylinder would admit, and this chamber is stiffened on the roof by bar stays against collapse.

The back fire box plate *i* contains the fire-door opening, and is studded to the back plate of the outer box in the usual way.

The outer back plates *m* and *l* are plain flat plates, but the end plates *g* and *i* of the inner box are corrugated in concentric rings like the plate of a Schaffer pressure gauge or the diaphragm of an aneroid barometer.

This novel fire-box is seen to have many advantages. Though it does not entirely dispense with stud stays as does the Strong system, yet it very largely reduces their number, and disposes them where exposed to less rocking stresses than in the rectangular box. Any stresses of serious amount on the stays between the plates *g*, *i* and *l*, *m*, will be kept in bounds by the elasticity of the corrugated portions.

It might have been better had the Adamson flange been adopted for the seam *s* at the rear of the fire-box. This seam is in a very hot portion of the box, and it is just possible may give trouble, as also may the seam *n*.

It will be noted that the section of fire-box on line *x y* is two complete circles; the

section at *v w* is as shown in Fig. 2, while that of the combustion chamber *e* is as shown in Fig. 3.

This combustion chamber occupies a portion of the length of the boiler usually occupied by flue tubes, thus reducing the tube length by this amount. Webb's new boiler appears to present no obstacle to use on his ordinary locomotives.

The back plate of the outer casing is flanged as shown, to enable it to be riveted by machine externally, for final attachment to the shell. It is worth notice that every portion of this boiler is very simply formed, and can be pressed from the flat plate without special distortion of any portion of the plates operated on, and without the formation of much waste material.

It is stated that the fire-box surface is 132 square feet, as against 94½ in the ordinary type of equal sized boiler, but it is pointed out that this entire surface is obtained by a sacrifice of such portion of the tube surface as is displaced by the combustion chamber; nevertheless the performance is highly satisfactory.

It is a weary process endeavoring to persuade engineers that much of their vaunted tube surface is not worth its house room. It has been proved so by experiment many years ago, and the writer has for years argued and written against the absurd and useless excess of tube. Now, in Mr. Webb's boiler it is deliberately curtailed, and the true steam raising surfaces, those of the fire-box proper, have been increased with highly satisfactory results. Mr. Webb has made other notable departures in locomotive engineering, and this last is not the worst or least important. It is a distinct concession to the ideas of the stationary engineers, who have with ordinary drafts always found the best results from the simplest forms. Engineers not bound by a slavish adherence to the "*results of the Rainhill competition of sixty years ago*," are pretty well agreed that fire-box surface is of the first importance in steam raising, and tube surface very far behind. Designers who cannot get out of the rut should bear in mind that the vaunted tubular boiler of the Rocket had fifteen tubes of three inches diameter only. The success of the Rocket at the Rainhill competition was not a matter of tubes at all, though it happened that Booth's tubular boiler was used. The real cause of success was the excellent combustion attained in the fire-box by the turning of the exhaust steam up the chimney. Whether this was done to improve the draft or merely to get rid of the steam, seems to be still a matter of debate, but the miserable fifteen tubes got the chief credit, and have since developed into the hundreds of 1½" and 2" tubes. Will any locomotive engineer try going back to the old size again of 3" or 4", and use fewer at that, so as to leave a little of the tube plate still unoccupied?

Modern Locomotive Construction.

BY J. G. A. MEYER.

NINETY-FIFTH PAPER.

Fig. 530 represents a wrought-iron steam gauge lamp bracket, for the throttle valve gear shown in the last paper; its end *p* is inserted in the hole *g* in the lower part of the stand *A*, and fastened there; the steam gauge lamp is screwed onto the end *l* of the lamp bracket.

In this design of throttle valve gear the pitch line of the teeth in the circular rack must be described from the center *d*, and not from a center lying to the left of the center line of throttle rod, for instance such as we were compelled to find by the construction shown in Fig. 524.

For obtaining the length of the circular arc, that is, the distance from *h* to *i*, Fig. 531, we simply describe from the center *d* the arc *h i*, which contains the outer extremities of the teeth, and then proceed as follows:

Let the point *d*, Fig. 531, represent the position of the center of the pin when the throttle valve is closed. Through the point *d* draw the center line *m n* of the valve rod, and on this line mark off a point d_2; the distance between the points *d* and d_2 must be equal to the distance through which the center *d* of the pin will travel to open the throttle valve fully; this distance is found as explained in the ninety-third paper, and is usually about two inches, or a little more; in some cases it may be as much as 2½ inches. Lay off a point *e* to represent the center of the lug cast on the steam gauge stand; the location of the point *e* must, of course, correspond to the position of the point *d*. From the point *e* as a center, and with a radius equal to the distance between the centers of the holes in the link *I* (Fig. 529), describe a short arc *r s*; also from the point *d* as a center, and with a radius

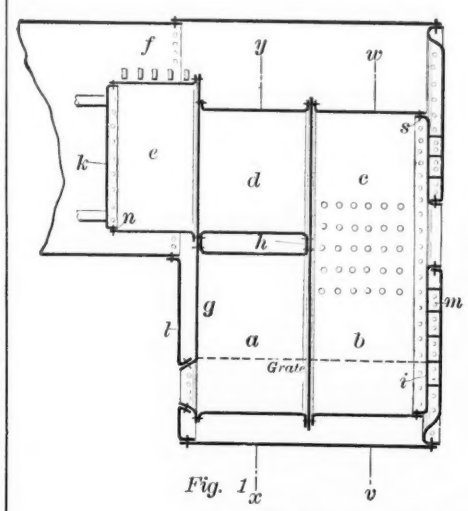


Fig. 1

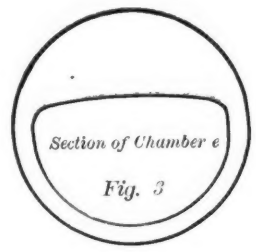


Fig. 3

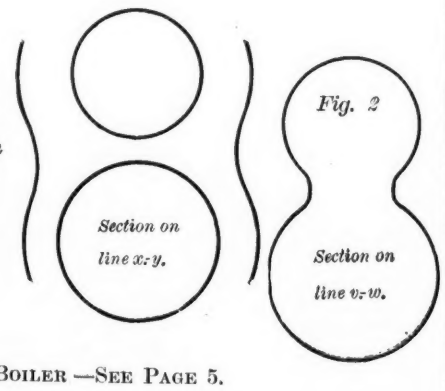


Fig. 2

A NEW LOCOMOTIVE BOILER —SEE PAGE 5.

equal to the distance between the centers *d* and *e*, that is, the given distance between the centers of the holes in the lever *E*, describe an arc *t u*, cutting *r s* in the point *e*; the straight line joining the points *c* and *e* will be the center line of the link *I*. Through the points *e* and *d* draw a straight line, and produce it towards *L*, cutting the arc *h i* in the point *g*. Now the center line *e L* indicates one of the extreme positions of the throttle lever *E* (that is when the throttle valve is closed), and theoretically the arc *h i* need not extend beyond the edge *v* of the latch *L*; but, in order to allow for wear and inaccuracies in fitting, the distance from *g* to *h* is usually such as to extend one-half of an inch beyond *v*; hence the total distance from *g* to *h* measured on the arc *h i* will be about three-quarters of an inch.

Through the point *d* draw a line *d k*, perpendicular to *m n*, cutting arc *h i* in the point *q*, and thus obtain the distance *h q*; that is, the distance from the point *h* to the line *d k*, measured on the arc *h i*.

If now a line *w x*, perpendicular to *m n*, be drawn through the point *w*, that is, the middle of the distance *d* d_2, and the line *w x* passes through the point *e*, as shown, then the motion of the lever *E* will be symmetrical on each side of the line *e w*; under these conditions we have only to make *i q* equal *h q*, and thus obtain the whole length of the circular rack *h i*.

If the line *w x* does not pass through the point *e*, then, the point *h* having been found as before, the point i_2 will be found in the following manner:

Through the point d_2 draw the line d_2 k_2, perpendicular to *m n*; also from d_2 as a center, and with a radius equal to *d e*, describe an arc to cut the arc *r s*; in practice the point of intersection thus found will generally be so near to the point *e* that we may consider the

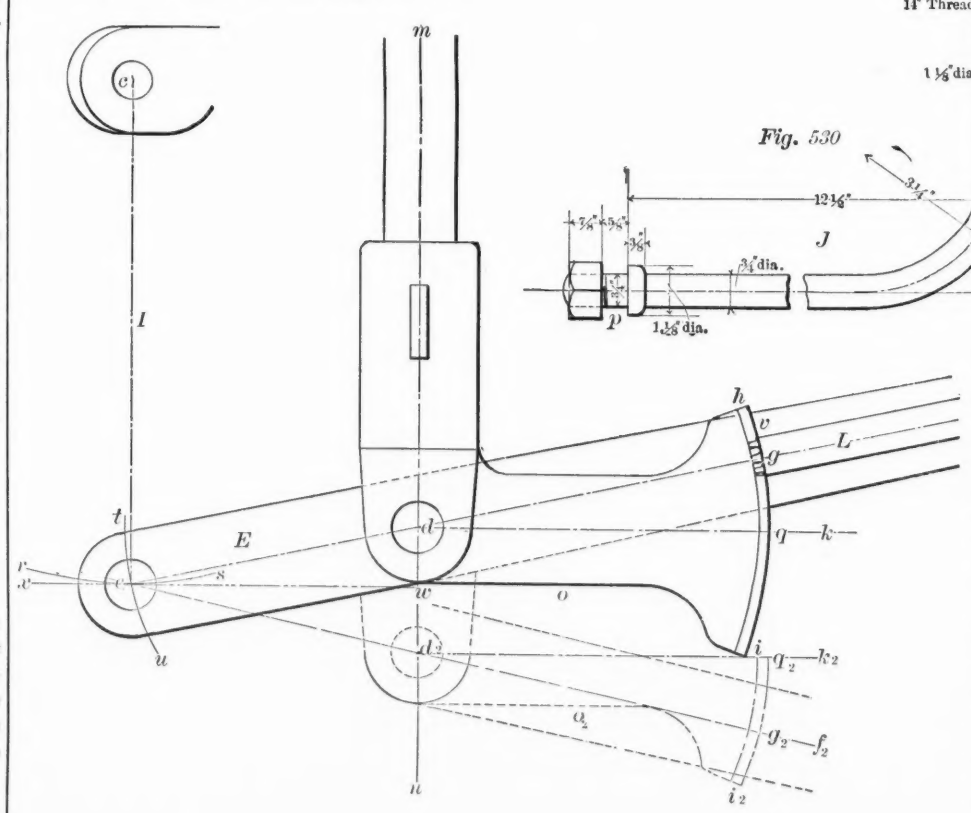


Fig. 531

MODERN LOCOMOTIVE CONSTRUCTION.

Through the point d_2 draw a line d_2 k_2, perpendicular to *m n*; also from d_2 as a center, and with a radius equal to *d g*, describe the arc q_2 i_2, cutting *e* f_2 in the point g_2, also cutting the horizontal line d_2 k_2 in the point q_2. Make g_2 i_2 equal to *g h*, and add the arc q_2 i_2 to the arc *h q*, and thus obtain the whole length of the circular rack.

In our last paper we have shown a throttle valve gear attached to the top of boiler, with the throttle rod passing through the side of the dome. Figs. 532, 533, 534 (page 7) represent another throttle valve gear also attached to the top of boiler, but differs from the former in having the throttle rod *H* pass through the top of the boiler, instead of passing through the side of the dome.

Fig. 532 represents the relative positions of the steam gauge stand *A*, the stuffing-box *B* with gland *C*, and the throttle lever *E*. Fig. 533 simply represents a plan of the stuffing-box and gland, the throttle lever, and the notched arc *D*; the steam gauge stand is not shown in this figure.

Fig. 534 represents the relative positions longitudinally of the stuffing-box and steam gauge stand; and Fig. 535 represents a plan of the latter.

The throttle rod *H* stands in a vertical position. The parts of the throttle rod which pass through the lever *E* and the crank *I* are cut square.

In Fig. 532 the line *d* is the center line of the boiler, and since the center line of the throttle pipe in the dome coincides with the line *d*, and since the center *f* of the connection of the small crank *I* should also coincide, or nearly so, with *d*, it follows that the stuffing-box must be placed on one side the center line *d*.

The joint between the stuffing-box and top of boiler is a ground ball joint; around it, the thickness of metal is increased by riveting a small plate *K* to the inside of the boiler, and thus obtain a sufficient depth of metal for the thread on the studs *a*, a_2 a_2, which fasten the stuffing-box to the boiler; the studs a_2 a_2 are made long enough to take hold of the gland *C*.

The steam gauge stand *A* is fastened to the top of boiler with two studs *b b*. The depth *e* of the steam gauge stand flange may seem to be excessive; this depth, as well as the distance from the top of the stuffing-box flange to the top of boiler, will be governed by the following conditions:

The designs of throttle valve gears shown in Figs. 532 and 525 are generally required for boilers which extend nearly to the rear end of the cab; the portion of the boiler inside of cab must be lagged, as well as the outer portion, so as to prevent a loss of heat by radiation, and also to prevent the cab from becoming uncomfortably hot for the engineer. The distance between the outer face of lagging and the boiler usually varies from about 1½ to 2 inches; now, in order to make a nice and easy finish of the lagging around the steam gauge stand and stuffing-box, the upper faces of their flanges are made to extend about one-quarter of an inch beyond the lagging; hence the excessive depth *e* of the steam gauge stand flange, and the seemingly unnecessary height of the stuffing-box flange.

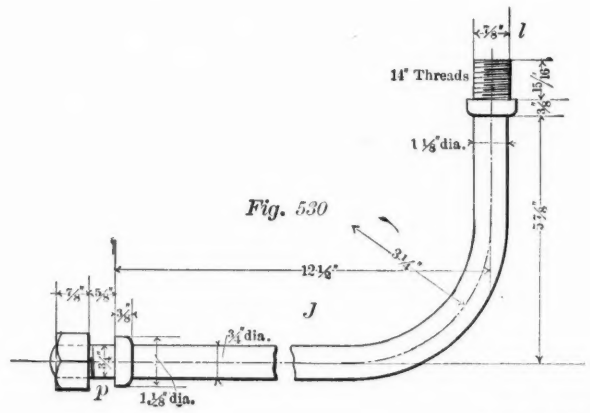


Fig. 530

The notched arc *D* is bolted to the steam gauge stand; this arc must, of course, be described from the center of the throttle rod *H*. It will be noticed that in this design the arc *D* is made to pass through the throttle lever *E*, instead of being placed below or above it, as shown in some of the other designs of throttle valve gear. The manner of locking the throttle lever *E* is so plainly shown in Fig. 533 that an explanation is unnecessary.

The arc *g h i*, Fig. 533, represents the path of the end of the throttle lever; the distance between its extremities *g* and *i* is usually about 12 inches, and should not exceed 18 inches. Now, to keep the movement of the end of the throttle lever within these limits, and in the meantime give the throttle valve the required lift, no more and no less, we must assign a suitable length to the crank *I*, in Fig. 533. But in many cases the boiler braces will determine the position of the stuffing-box *B*, which will also fix the length of the crank *I*; the length thus found may not be suitable for keeping the movement of the throttle lever within the given limits;

under these conditions we must give such lengths to the arms of bell crank *B*, Fig. 493, as will produce the desired results. The given limit of the movement of the throttle lever will also, in many cases, determine the distance between the holes *e* and *d* in Fig. 531.

A Needless Wreck.

The recent fatal wreck on the New York, New Haven & Hartford Railroad, emphasizes the fact that, in order to make railroad travel reasonably secure, something more than careful and competent engine and trainmen are needed, and that those who are engaged in railroading, and those who ride upon trains, take the risks arising from the employment of the most ignorant, the most careless and the most incompetent man employed by the road, no matter whether he be on the same or another train, or on no train at all. The enginemen of the wrecked train are presumably entirely trustworthy and competent, but such ignorant and reckless trackmen as those concerned seem to be, could, of course, wreck any train, no matter how well manned or carefully managed. The injustice and wrong of constantly impressing upon engine and trainmen the necessity of perpetual and unrelenting vigilance in the avoidance of accidents, and then having them run over tracks the security of which depends upon trackmen entirely ignorant of the nature of the responsibility devolving upon them, and entirely lacking in the good judgment and intelligence necessary for safe decisions upon questions constantly arising, cannot be too severely condemned. It has been made plain by the coroner's inquest that there was no excuse for letting the train run at full speed on half-spiked rails, and the only reason it did so was because of mistaken judgment on the part of the trackmen, who thought there were enough spikes driven to hold them. It must be evident that the blame for this can be definitely fixed upon some one, and we hope the company who so manages things that such an accident is possible will not escape its just share.

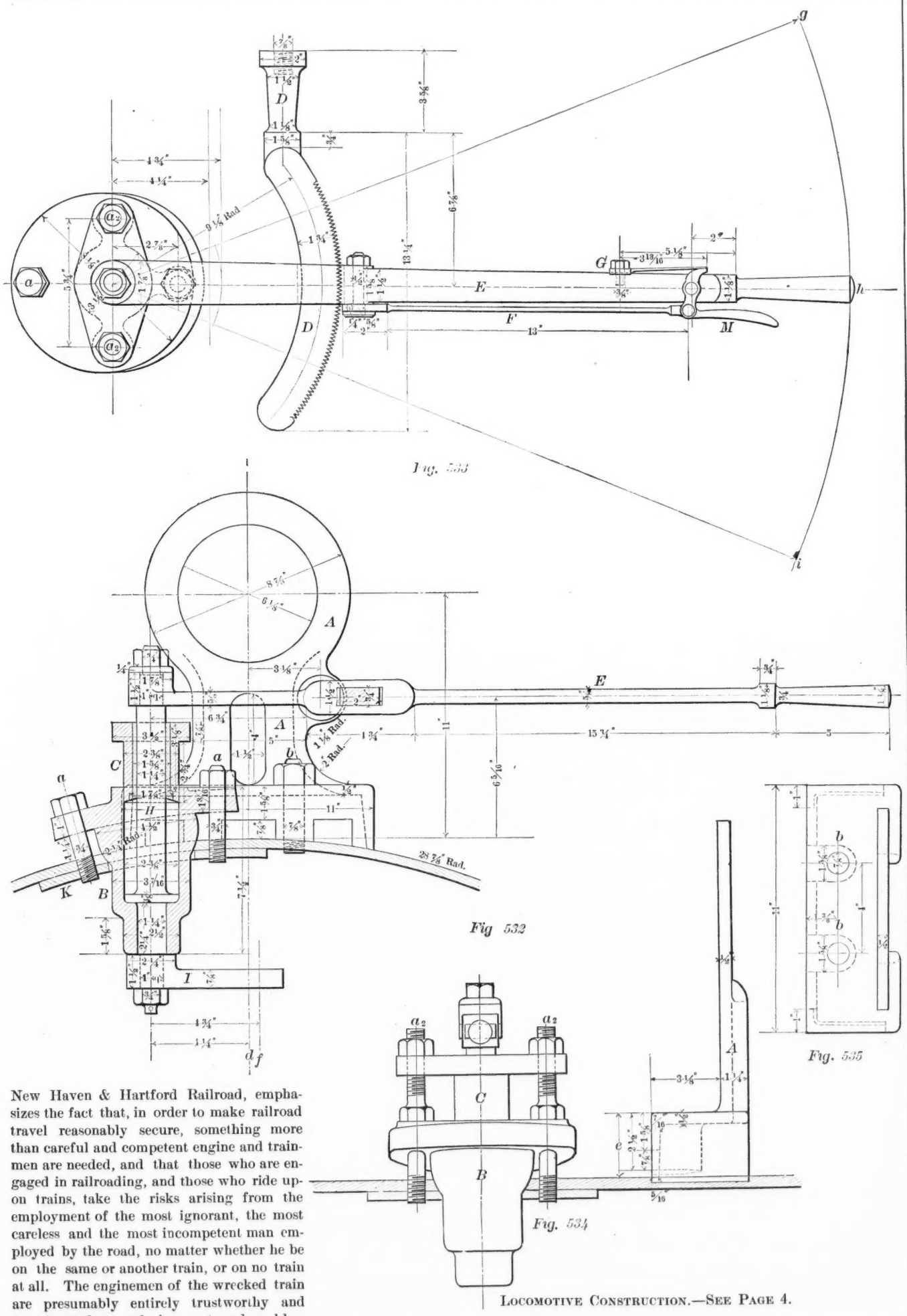


Fig. 533

Fig 532

Fig. 535

Fig. 534

LOCOMOTIVE CONSTRUCTION.—SEE PAGE 4.

LETTERS FROM PRACTICAL MEN.

Some Points in Foundry Practice.

Editor American Machinist:

I suppose many old moulders will agree with me when I say, "any chaplets wedged up in the morning get loose before casting time in the afternoon."

I found that out some years ago, when I was making heaters, with a flat core in them, 4ft. long, 6" wide, 1" thick. Some of them had 4 chaplets and some 5, and, as I was making some 16 a day, I went "stove-plate" on it (as they say) when you clamp up as you go along, and the consequences were that, no matter how firm the chaplets were wedged in the morning, they were all loose when I went around to feel them in the afternoon, and, as I have found a very good plan to keep the wedges from falling out, I will try to describe it. When the chaplets are wedged up, take a handful or so of sand and place it around the chaplet up to the wedge, and then if it is a little loose it will not fall out, as I have seen them do several times; or as I have seen it done in a case of emergency, when you have no wedge, put a little sand around the chaplet up to the cross-bar and then clean a little of it away and pour a little iron around the chaplet under the cross-bar, then it will be safe. A very good way to make cast-iron wedges is as follows: Throw up the sand heap to an angle of 45° or so, and take a long gate stick or a sash weight, and bed it in the sand, up and down from top of sand heap to the bottom, get a pattern of a wedge, and push it down in the groove made by the sash weight, and pour them, commencing at the top; when that is full, the iron will run down to the next one, and so on; then you will have some respectable wedges, not like some I have seen, with a lump on the top of them the size of a small cupola.

THOS. WATHEY.

Joshua Rose has been writing some very interesting letters to the *Scientific American* regarding things seen by him at the Paris Exposition, and in one of these he took occasion to speak of the extent to which American machinery was copied by English and Continental machine builders, and made a very unfavorable showing, especially for the former. Now comes one of our English exchanges and heaps ridicule upon Mr. Rose, calling him our "American critic," "the intelligent Yankee," and "the great Pajandrum," whatever that may be, and winding up by congratulating itself that "all our American critics are not wrapped up in such utter and monstrous conceit as this representative of the *Scientific American* in Paris!" The joke of all this will no doubt be fully appreciated by those aware of the fact that Mr. Rose is a thorough Englishman, born and raised in that country, and now living in London, but having been in this country sufficiently long to make him familiar with American practice in these matters.

The *Colliery Engineer* says:

Hon. Alfred Bolles, Chief of the Bureau of Statistics, has adopted a new method of ascertaining the average wages paid in the coal mines of Pennsylvania.

He forwarded to the different collieries blanks in which the wages of ten miners in each colliery receiving the highest amount, and ten receiving the lowest amount, were asked to be recorded. In this way the wages of about 2,000 miners have been received at the Department of Internal Affairs from about 130 collieries. The wages of the best-paid miners amount to over $700 a year, and the lowest to $200. The average in the anthracite and bituminous regions, Mr. Bolles says, will be about $500. A considerably lower figure prevails in the bituminous than in the anthracite region.

The value of this method of obtaining such information seems to us to depend very much upon who received and filled out the blanks at the various collieries, and upon whether or not pains were taken to see that proper deductions were made for the cost of powder and other things charged to the miners by the companies at prices far above their value, for helpers, and for the extra cost of compulsory trading at "pluck me stores."

In regard to the selection of belts for various kinds of machinery, an engineer has prepared, in general, the following advice as a result of considerable experience. Belts of a light color should be selected in preference to darker ones. Superior belting having an unmistakable light buff color, indicates that it is oak tanned, and that the leather has been thoroughly washed. This removes all matter except the fiber. This light color is an indication that only the best qualities of grease have been used. An inferior quality of grease not only impairs the quality of the leather, but darkens the color.

We sometimes receive questions addressed to the "Question and Answer" column, which, because of a lack of general interest, or for other reasons, we prefer to answer by mail, and it quite frequently happens that, when we have done so, our letters are returned to us, because of the inability of the letter-carrier to find the persons addressed. Such cases most frequently occur where the persons live in large cities, and fail to give their street and number. This will explain to some of our readers the reason for their not getting replies to their questions.

AMERICAN MACHINIST

To prevent delays all Communications should be addressed to the Company.

PUBLISHED WEEKLY
BY
American Machinist Publishing Co.
96 Fulton Street, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
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NEW YORK, JULY 11, 1889.

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The Anthracite Monopoly.

We have received several communications referring to our article on "Soft Coal in New York," some of which advance the idea that its increasing use is a perfectly natural thing, due entirely to the restricted supply of anthracite, while others say in effect that it is not due to this, but to unfair rates of transportation by which the producers of anthracite are made to pay about four times as much for getting their coal to market as the producers of bituminous coal have to pay. One of these communications calls attention to an editorial article in the *Colliery Engineer* for June, in which this matter of discrimination in rates is spoken of, and the report of a committee of the Scranton Board of Trade is quoted. This committee was appointed to consider this matter of transportation, and, though composed, of course, of intelligent men living in the heart of the anthracite regions, actually treats the matter as if its members thought that the railroad companies controlling the anthracite carrying trade would be liable, upon having the matter presented to them, to consider it upon its merits on a basis of fair dealing, or possibly with some regard for the interests of the citizens of Scranton.

We confess that we are considerably surprised at such evidence of sublime and childlike faith in these companies, by men who live and do business where it may fairly be supposed that there are the best of opportunities for observing things well calculated to destroy such faith. Do they not know that the railroad companies to whom they appeal are themselves the principal producers of anthracite coal? That the rates charged for its transportation to market constitute part of the price received for its production? That these rates are made high and the price of coal at the mines low, in order that individual mine operators who have no interest in railroads may be prevented from competing with them upon anything like equal terms, and be thus the more readily induced to sell out their mines to the large companies whenever it happens to suit the convenience of the latter to purchase them?

All the rest of the world knows these things, and if any further testimony were needed to prove them, it is to be found in the recently published report of a committee of Congress, appointed for the purpose of making an investigation into the methods of these gigantic plunderers. During this investigation, of which we are in possession of an advance copy of the official reports, it was shown conclusively that these very railroad companies which the Scranton Board of Trade committee asks to consider the interests of anthracite producers, themselves control its production, and that they are therefore, in effect, asked to arrange their business affairs so that outsiders may be able to make more money, when those affairs are already so arranged as will, in the judgment of the companies, make the greatest possible returns for them—a thing which, if we are to judge from the past, they will be in no haste to do.

It may be that the increasing use of soft coal, where anthracite was formerly used, will prove to the anthracite companies that they have over-estimated the preference of manufacturers for anthracite coal, and lead them to reduce cost to consumers of the grades suitable for steam making. But such reduction, if made, will be so made as to benefit the companies, not the citizens of Scranton or individual mine operators.

And while we are upon this subject, it may be well to remark that the condition of affairs in Pennsylvania revealed by the testimony taken in this investigation, is sufficient to bring the blush of shame to the cheek of any American citizen who, having the least power to assist in remedying them, fails to exert that power to the fullest extent possible. Not only is the general public systematically and outrageously robbed by these monopolizers of nature's bounties, and a heavy tax laid upon all forms of productive industry, but human beings capable under decent conditions of development into citizens in every way desirable for a great republic, are rendered a standing menace to the security of republican institutions, and are reduced to a condition of hopeless misery, compared with which the slavery of former days was far more merciful and desirable.

A Good Text.

The way to get large financial returns is to learn to do something that few others can do; the fewer the better.

The foregoing, which is from a lecture, by Amos Parker Wilder to the students of Yale University, while addressed especially to newspaper workers, furnishes one of the best texts for mechanics that we know of. It need not be inferred that one must know how to do something that no one else knows anything about; that is not the meaning; it is all covered by saying he should learn to do something *better* than others are doing it.

As the world moves along we are sure to find others jostling us, and the only way to get rid of most of this jostling is to move ahead out of its reach. That is simply acting up to the great natural law of self-preservation.

The only sure way of knowing whether or not we can do something better than others can is to find out what others have done and are doing, not in the narrow sphere which we can overlook, but in the world outside.

The greater part of the wisdom of the philosopher consists in an application of the knowledge of others. The astronomer is able to make his calculations mainly because others have calculated before him, and others are still calculating, and he knows what they have done. In this respect the mechanic should copy the philosopher and the astronomer. Either is foolish if he builds a foundation when one, at a trifling cost and trouble, is at hand.

Certain papers published in this city are making a great fuss over the recently enacted law of New York State fixing the wages of laborers in the employ of the State at $2 per day. There is a good deal of shrieking about demagogic legislation and socialism, etc., and it is asserted that certain employes of the State, who have heretofore worked twelve hours per day at $35 per month will actually receive an amount hereafter which, it must be admitted, will enable them to live and support their families in some degree of decency. While this is greatly to be deplored, of course, we really don't see how it can be helped so long as the laboring men have votes; for so long as they retain their right to vote, and have something to say about who shall be elected to the State legislature, it is to be expected that their unreasonable prejudice in favor of living wages will receive some attention from the State when the State is the employer. If the franchise could be taken away from men who are obliged to labor for their living, then there can be little doubt that the politicians would fix the rate of wages paid by the State at a figure which would be entirely satisfactory to those who, by reason of their not being obliged to labor, had retained their right to vote. But there would be practical difficulties in the way of doing this, and so long as these difficulties remain we fear that the State will pay to such of its citizens as it requires to labor in its service, good wages. And after all, we know of private employers who pay somewhat better wages than the ruling rates because they think it is profitable to do so. No one doubts their right to do this, and we fail to see why the State has not the same right.

Literary Notes.

THE CRANK: Its Motion and True Value for Transmission of Power in Practical Engineering. By F. Lenggenhager, Ph. D., late Engineer to the Maritime Stations of the Austrian Empire. With Explanatory Notes and Diagrams. D. Van Nostrand Company, 23 Murray and 27 Warren Streets, New York. $1.50.

This is a book which it is impossible to treat seriously. Its author, evidently knowing almost nothing of the laws of physics, and being utterly unable to correctly apply what little he does know of them, imagines that there is a great controversy going on with regard to the value of the crank motion in engineering, with himself ranged on one side and the rest of the mechanical world—at least that part of it which inhabits America—on the other, and that he can prove that his side of the question, *viz.*, that half the power furnished by the motion of the piston of an engine is destroyed by the crank, can be proven by the liberal use of italics and capitals, exclamation and interrogation points.

If there is a single logical paragraph in the book, we have been unable to find it; but of curious questions printed in italics or capital letters, and finished off with groups of interrogation points, and which the author declares must be answered in order to settle the matter, there are plenty. Yet there is no answer to most of them, simply because the questions themselves have no meaning.

For instance, on page 46 he says in italics and capitals: "Here arises the question—and it must be settled—is the proportion of speed inherent to the piston and crank, or is it the speed itself?"—a question to which it must be admitted there is no answer.

The author seems unable to grasp the significance of the law of the conservation of energy, and advances the novel idea that no slow-moving force can possibly be of any assistance to a more rapidly moving one, and that during all that part of the revolution of an engine in which the crank speed is greater than the piston speed, the piston can have no effect on the crank. Of course, argument is useless upon such a proposition, and as this is a fair sample of the contents of the book, there seems nothing to do but to wonder how it found a publisher. We are gravely informed, among other things, that no machinist will be found in Europe who believes in the "no loss" theory; "the false idea of 'no loss of power on a crank' existing only on this side of the Atlantic." And also that, in the author's former career as marine engineer, he was specially detached to carry on investigations on the course and effectiveness of missiles, etc., etc., but that he speaks of these things "simply to make the reader feel confident that he knows pretty well what he is talking of when he treats on such a little thing as a crank is." The book is a mass of fantastical absurdities from cover to cover, and has value only as a curiosity.

QUESTIONS AND ANSWERS

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(277) I. M., Brooklyn, N. Y., writes: Please inform me why locomotive cylinders are always worn larger at both ends? *A.*—Locomotive cylinders do not always wear larger at the ends; when they do so, it is probably due to an imperfect alignment.

(278) J. W. B., Auburn, N. Y., writes: Please inform me how to find the horse-power of a boiler 20 feet long, 5½ feet diameter, forty-four flues 3 inches diameter. Also, one boiler 12 feet long, 4 feet diameter, and thirty flues 4 inches diameter. *A.*—See answer to Question 239, in our issue of June 6th, 1889.

(279) D. T. J. asks: If a lathe will face the face-plate off straight, does that prove that the spindle is true both ways with the bed of the lathe? *A.*—No, it does not prove that the spindle is in line with the bed either way. It simply proves that the spindle is at right angles to the cross-slide. Both may be out of square with the bed and the spindle may be out of line vertically.

(280) "Young Apprentice," San Francisco, Cal., writes: Please inform me what gears I should use to cut 13½ threads to the inch with a lead screw 4 threads to inch, the number of the teeth in the gears increasing by 2 and 4 up to 96? I send a list of the gears. *A.*—You cannot cut such a thread without making one new gear. You can cut it by making a gear of 81 teeth for the screw, using 24 on the stud; or you can make a gear having 108 teeth for the screw and use 32 on the stud. You will find the rules fully stated in the answer to Question No. 70, issue of Feb. 14.

(281) R. H. P. P., Billings, Mont., asks: What forms of pipe joints are mostly used for mains not exceeding 200 or 400 feet, and their diameters not exceeding 8 inches? *A.*—You will find illustrations and descriptions of some of these pipe joints in Trautwine's Engineer's Pocket Book. An answer to your other question will be of no practical value; to work out the problem will be a tedious and complicated operation, and after all, only approximate results will be obtained. If you really need the information asked for, we should advise you to obtain it experimentally.

(282) A. D. H., Bangor, Me., asks: In splicing a timber 10″x14″, loaded on the 10-inch side, or, in other words, the load being applied to the top edge of the timber, which would be the strongest way to place the splice, at right angles to the load, or parallel with it? *A.*—The splice at right angles to the direction of the load will be the strongest, because such a splice is only subjected to a tensile and compressive stress. On the other hand, a splice parallel to the direction of the load will not only be subjected to tensile and compressive stresses, but it will also be subjected to a torsional stress, which all good designers will avoid as much as possible. With the latter splice the timber will also be more liable to split than with the former.

(283) J. W. T., New Orleans, La., writes: In an English work I find the following formulas:

$$G = \sqrt{H} \times d^2 \times 10$$

$$H = \left(\frac{G}{d^2 \times 10}\right)^2$$

$$d = \left(\frac{G}{\sqrt{H} \times 10}\right)^{\frac{1}{2}}$$

These formulas are for the discharge of water through an orifice in a thin plate. G represents the discharge of water in gallons per minute; H, the head in feet; d, diameter of the orifice in inches. The gallons here given are English gallons. Now the question is, what changes are necessary in the above formulas to adapt them to U. S. gallons? I believe that, by multiplying the factor (10) by 1.2, I will be all right, but I want your opinion. *A.*—You are right. By multiplying the factor 10 by 1.2, we obtain 12; hence, if 12 is substituted for 10 in the foregoing formulas, they will be adapted to U. S. gallons.

(284) E. T. F., ———, asks: What is the proper speed in feet per minute for turning, planing and milling cast-steel, wrought-iron, cast-iron and brass? *A.*—Much depends upon the character of the cuts taken, and we think it is almost useless to attempt to lay down any fixed rules for this. But for average conditions we should say that cast-steel could be most advantageously turned and planed at 18 feet per minute, and milled at 40 feet, when using plenty of good oil. Machinery steel, about the same, and also about the same for wrought-iron in milling, but somewhat faster for turning and planing, say about 20 feet. Cast-iron can be turned and planed at 20 feet, and milled at 50. Brass can be turned at 60 and milled at 85. It is to be understood, however, that these are only average figures, and that practice varies widely from them, according to the quality of the metal worked, the character of the cuts taken, the degree of accuracy and finish desired, quality of the tool steel used, and the character of the machines in use. Experience and good judgment are the only reliable guides.

(285) H. L., Peoria, Ill., writes: In your description of the *City of Paris*, in your May 23d issue, you say the main engines give about 20,000 horse-power. I would like to know if that is correct? And also if steamships overrate their horse-power to any great extent whenever a description of them is published. I have had a dispute regarding the matter and was told that steamers claiming 10,500 horse-power had actually not more than 1,500. *A.*—The horse-power developed by the engines of steamships may in some cases be exaggerated, though we do not think it is customary to do so, nor do we see what object could be gained by over-statement in the case of such a vessel as the *City of Paris*, since, her time being known, it would be the more creditable to her builders if she made that time at a small than at a large expenditure of power. The article relating to the vessel was written by an engineer connected with the AMERICAN MACHINIST, after a personal inspection of the boat; he, however, taking the word of Mr. J. B. Cousins, one of the second engineers of the vessel, regarding the power developed, not doubting that his word was to be depended upon in the matter. If any additional proof were needed, however, it can be found by making a few figures regarding the engines. Taking the dimensions, revolutions, etc., as given in the article, and assuming the mean effective pressure at 36 lbs. per inch (which is about what it would be at 150 lbs initial pressure), the two engines would give 19,684.8 horse-power, which practically bears out the statement made.

(286) C. J., Massillon, Ohio, writes: To settle an argument, please answer the following question: I order a boiler 60 inches in diameter, 16 feet long; would I receive a boiler 60 inches inside or outside diameter? In other words, is a standard boiler measured inside or outside? *A.*—We are not aware of any standard way of measuring the diameter of the boiler. If, for instance, it is not specified which of the two diameters is to be 60 inches, you may receive from some boiler makers a boiler 60 inches inside diameter, and from others a boiler 60 inches outside diameter. The following measurements we should consider to be fair under the given circumstances: A boiler 16 feet long is made up in courses; if these are simply straight inside and outside courses, we should expect to receive a boiler whose inside course is 60 inches outside diameter. If the boiler is made up of tapered courses lapping telescopically, we should expect the outer diameter of small end of the tapered courses to be 60 inches. If the boiler is made up of courses which butt against each other, so that practically the shell is of uniform diameter throughout, we will have to be satisfied with a boiler whose diameter is 60 inches outside diameter. It seems to us that, to order a boiler without stating whether it is to be 60 inches inside or outside diameter, or whether the given length is to be over all or not, is a very loose way of ordering a boiler. The proper way is to make a drawing of the boiler, showing all the braces, stay-bolts, flues, etc., complete, with such dimensions written upon it as to leave no doubt of what is wanted; the kind of material, rivets, etc., should also be marked on the drawing; in fact, the drawing should give complete instructions relating to the size and kind of boiler required. Boilers are dangerous things to tamper with, and if you are not competent to make the drawing and necessary calculations yourself, then give your order in the hands of a first-class engineer; the extra expense incurred will do more than repay you in the end.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue

Gear wheels and g-cutting. Grant, see adv., p. 16

Link-Belting and Sprocket Wheels.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Engineering Co., Philadelphia and N. Y.

20″ Upright Drills. J. E. Snyder, Worcester, Mass.

23″ Upright Drills. J. E. Snyder, Worcester, Mass.

25″ Upright Drills. J. E. Snyder, Worcester, Mass.

28″ Upright Drills. J. E. Snyder, Worcester, Mass.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Drop Presses, Punches and Shears. Williams, White & Co., Moline, Ill., manufacturers.

Hand, Nut, Taper and Pulley Taps. S. W. Card & Co., Mansfield, Mass.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

Small Dynamo and Motor Castings, $2.75, $3.75 and $4.75. H. Wellman Mfg. Co., Box 49, Catlettsburg, Ky.

Surface Plates 14″x14″x1½, $8.00; Scraped, $15.00. All sizes and styles. R. M. Clough, Meriden, Conn.

Ice and Refrigerating Machines, 131 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

"How to Keep Boilers Clean." A 96-page book mailed free by Jas. E. Hotchkiss, 120 Liberty st., N.Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortland st., N. Y.

Best silk wiping towels for machinery in the market. S. A. Smith, 23 S. Canal st., Chicago, Ill.

Iron Planers from 16″ to 36″ wide by any length. H. C. Pease & Co., Worcester, Mass.

For the latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Send $1 for Catalogue D. Fine Tools and Supplies. Over 550 pages Fully illustrated. Frasse & Co., 92 Park Row, New York.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

For Portable Key-seating Machines and Stub Ends for small connections, address T. C Dill Machine Co., 726 Girard ave., Philadelphia, Pa.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See June 20, p. 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

The best emery wheel made is the "Norwich." For particulars send to Montgomery & Co., 105 Fulton st., New York.

Rubber Belting, all sizes, 77½ per cent. from regular list. All kinds of Rubber Goods at low prices. John W. Buckley, 156 South street, New York.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing grey iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.

Steam Boilers: Their management and working on land and sea. By Jas. Peattie. Practical facts from 30 years' experience. 230 pages illustrated, 12mo., cloth, $2. Circulars and Catalogue of Books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N.Y.

Patent or shop rights for sale, for perforating iron or steel plates for steam boilers, bridge work, iron or steel ship work, marine boiler heads, equal to drilled work and fifteen times quicker. Samples can be seen and circulars obtained from R. E. Dietz, 60 Laight st., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1885 issue, and up to and including May 23, 1889 issue, 77 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 92 articles have thus far appeared up to and including the May 30, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES

A machine shop will be established at Americus, Ga., by W. H. Sawyer.

Work is going on night and day at the West Troy gun foundry plant, on 8 and 10 inch guns.

At Cartersville, Ga., the East & West Railroad Co. will erect machine shops and a roundhouse.

The box factory of Snodgrass & Field, recently burned at Chattanooga, Tenn., will be rebuilt.

A spoke and hub factory will be erected at Macon, Ga., by J. A. & W. A. Roush, of Petersburg, Ind.

The Chapman Valve Works, at Indian Orchard, Mass., are being enlarged by an addition 50x128 feet.

A large saw and planing mill will be erected at Jackson, Ala., by W. A. Willingham, of Chattanooga, Tenn.

The Hostetter saw mills at Norfolk, Va., have been purchased, and will be enlarged, by Freeman & McNeal.

E. E. Brown and W. H. Wagoffer of Philadelphia, are looking through the South for a favorable site for a machine works.

A large iron foundry will probably soon be built by the Chesapeake Dry Dock and Construction Co., at Newport News, Va.

A special catalogue of books relating to electrical science has been issued by E. & F. N. Spon, 12 Cortlandt street, New York.

Furniture and agricultural implements will be manufactured at Texarkana, Ark., by the Southern Planing Mill and Manufacturing Co.

The enlargement of the Baldwin Locomotive Works at Philadelphia is contemplated by the erection of two wings 80x80, and 34x138 feet.

A Pennsylvania firm has offered to take stock in payment for machinery for an 8,000 spindle mill which it is contemplated to erect at Huntsville, Ala.

A hundred ton iron furnace will be built at East Birmingham, Ala., by a company which has been organized by George A. Vanderbilt, of Jersey City, N. J.

The Jagger Iron Works at Van Rensselaer Island, N. Y., have been sold to P. J. McArdle, who will build a rolling mill, and probably employ a large force of men.

It is reported that the Louisville & Nashville Railroad will build shops at Middlesborough, Ky., as soon as their extension of the Cumberland branch is completed.

Work is soon to be commenced on an enlargement of the Sterling Steel Works, at Demler, Pa., the capital stock of the company having been increased for that purpose.

A paper mill will be built at Sioux City, Ia., having a capacity of twenty-four tons of paper and pulp per day. D. H. & A. B. Toner, of Holyoke, Mass., are making the plans.

The building of machine shops at Paducah, Ky., by the Paducah, Hickman & Southwestern Railroad Co., is contingent upon the city voting a $60,000 subscription to the capital stock of the company.

Extensive improvements and additions are being made to the old Wheeler foundry, recently purchased by the Holyoke Machine Co., Worcester, Mass. One building 75x75 feet, and one 75x150 feet are to be erected.

The Reliance Gauge Co., Cleveland, Ohio, report business very good, especially in the line of safety water columns, they having recently filled their fourth order for these from the Meriden Britannia Company, of Meriden, Conn.

The American Tool Works, of Cleveland, Ohio, intend to enlarge their plant, and will probably put in a compound condensing engine of 150 to 200 horse-power. Part of this power will probably be distributed to others by electricity.

The Tanite Co., Stroudsburg, Pa., have brought out a new form of surface grinding machine. The spindle has a traverse motion endwise, while at the same time the work is traversed under the wheel by a motion similar to that of a planer.

Some very heavy castings have recently been made at the West Point Foundry, Cold Spring, N. Y., which are to go to the Calumet & Hecla Mine. A cylinder was cast there Saturday, the 29th, which was 9x15 feet, weighing 56,000 pounds.

The erection of new water-works or the enlargement of those in use is contemplated at Washington, Ga.; St. Michael's, Md.; Statesville, N. C.; Columbia, S. C.; Nashville, Tenn.; Newbern, Tenn.; Cuero, Texas; Meridian, Texas; Fredericksburg, Va.; Shelbyville, Ky.

The Binghamton Hydraulic Power Co., Binghamton, N. Y., have taken up the manufacture of an improved vise for filing and setting circular saws heretofore made by A. Winkler, of Catskill. It fastens to a bench, and is well calculated to facilitate the operation named, and secure good work.

Nicholsen & Waterman, Providence, R. I., have issued a small pamphlet containing what they call an essay on finished nuts and bolt heads. It contains cuts and descriptions of the line of machinery for such work made by them, and which have been illustrated and described in the columns of this paper.

A finely gotten up catalogue of machinery for working and handling stone and marble has been issued by the Lincoln Iron Works, Rutland, Vt. It includes cuts and descriptions of stone sawing machinery of various styles, stone planers, jointing machines, hoisting machinery adapted to use in quarries. A number of useful tables pertaining to quarry machinery are also given.

Mr. Powell, of Washington, inspector of fuel and electric lights for the United States public buildings, has been in Boston on a tour of inspection. It is stated that five new boilers of large and improved pattern will soon be put into the Federal building here, to replace the seven now in use. The cost of the new boilers will be $10,000.—*Manufacturers' Gazette.*

The P. C. Holmes Company, Gardiner, Me., received an order last week for a pair of big gears for the Hamilton Mills in Lowell, which will weigh about five tons. They have removed the old lumber storehouse from just below the machine shop to the other side of the street, and are preparing a lot for the erection of their new foundry.—*Manufacturers' Gazette.*

The Minnesota Car Company's buildings at Duluth, Minn., are completed, and the machinery for the different departments, rolling mills, steam wheel forge foundry and erecting shops is now being put in, and in a very short space of time the works will be engaged in the manufacture of cars to the number of fifteen a day. The two large batteries of boilers are in position.

The Cambria Iron Company and the Gautier Steel Company, Johnstown, Pa., paid their men for the first two weeks of May last. The Cambria Company's pay roll aggregated $95,000, and the Gautier Company's $54,000. Of the 5,000 employes of the Cambria Company, but 3,500 are now at work, and of the 1,350 men formerly employed at the Gautier Works, but 950 are reported living. The Cambria Company have shipped two consignments of steel rails which were held in stock at the time of the disaster.

The immense plant of the Reading Iron Works, which failed four months ago for over $1,000,000, was put up for sale July 1. There was a large attendance of leading iron men of the State. In forty minutes after the bidding began, the property in its entirety, which includes furnaces, rolling mills, tube mills, pipe mills, foundry, forge, etc., besides valuable tracts of land, was sold to William P. Bard, of Pittsburgh, for $150,500, subject to a mortgage of $600,000. Mr. Bard purchased it for the Philadelphia & Reading Railroad Company, and the works will resume operations at an early day.

Chairman Blanchard, of the Central Traffic Association, has received a reply to a request that the Interstate Commerce Commission make a ruling as to the legality of proportional tariffs. Chairman Cooley answered that the point was doubtful, and that the commission did not see its way to a ruling that such tariffs could be made under the law. He holds that joint through tariffs may be made, in which the proportion accruing to each road is less than the local rate for the same distance, but questions the legality of one road making a proportional tarriff, where there is no agreed through rate.

A catalogue has been published by the Williams Engine Works, Beloit, Wis., which, besides information pertaining to the Williams engine, has much matter in it which will be found useful to those in charge of engines, no matter of what kind. There are numerous tables given, together with explanatory diagrams and rules for computing horse-power and mean effective pressure, etc. Interspersed through the book in convenient places are leaves ruled in squares for sketches and memoranda. Rules for mensuration are also given, accompanied by suitable cuts, and altogether the catalogue is a very desirable one.

The Minnesota Iron Co., of Duluth, having a surplus of $1,300,000 from the last year's business, has decided to build a fleet of large vessels for the ore carrying trade. The company is shipping this year, together with the Chandler mine, nearly 30,000 tons a week. The vessels to be built to carry over 100,000 tons a month. The only company which has recently entered upon the construction of its own vessels has been the Cleveland Iron Mining Co. It has now a fleet contracted for and partly built. One or two companies in the Marquette and neighboring districts have for several years owned a few ships.—*Boston Commercial Bulletin.*

Machinists' Supplies and Iron.

NEW YORK, July 6, 1889.

Iron—American Pig.—The market retains the firm tone noted last week, and the indications are that the higher level of prices will be maintained, at least for a time. We quote Standard Northern brands, No. 1 X Foundry, $16.50 to $17.50; No. 2, $15.50 to $16. Southern brands, No. 1, $16 to $16.50; No. 2, $15 to $15.25; Grey Forge, $14.50 to $15.25.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Situation wanted by mech. draftsman; good ref. New York or vicinity pref'd. BOX 112, AM. MACH.

Wanted—By first-class machinist, situation as foreman of general machine shop. J. A., AM. MACH.

A first-class brass foundry foreman wishes to change. Address Box 111, AMERICAN MACHINIST.

Wanted—Machinist; a skillful hand on chuck work; good wages to an A 1 mechanic. Address with reference, Metric Metal Co., Beaver Falls, Pa.

Agency or opportunity as salesman wanted by gentleman with tech. education and long exp. in the manufacture of mach'y. Agent, AM. MACHINIST.

Wanted—One good draftsman for machine shop drawings, steam engines, boilers, etc.; state age, exp., and salary expected. Kenney & Co., Scottdale, Pa.

General supt., having push and energy, desires engagement; good draftsman, designer and machinist; understands men and modern methods. B G. L., Claymont, Del.

Wanted—Metal pattern maker for light, accurate work; good wages to a thoroughly competent man. Address with reference, Metric Metal Co., Beaver Falls, Pa.

Civil engineer, having lived in France for 3 years, would like to act as secretary or assistant to gentleman going to the Paris exhibition on business. Apply Mr. B., *Herald*, Brooklyn office.

Wanted—A thorough mach'st, capable of handling men to good advantage, to invest $4,000 to $5,000 in a well-paying mach. business. Rare chance for enterprising young man. Enterprise, AM. MACH.

Wanted—An active and persevering man of good character to travel and solicit orders for steam engines and general machinery. Address, stating age, experience, and salary expected, Homo Ferro, care AMERICAN MACHINIST.

An experienced mechanic who can improve upon methods of doing work, manipulation of machines, systematizing factory work, designing labor-saving tools for doing work cheaply, desires a position as supt. or experimenter. Successful, AM. MACHINIST.

Wanted—By a foundry and machine works with rapidly growing trade, a thorough moulder or machinist with from $3,000 to $5,000, to take an interest in the business, and act as foreman; must be a thorough mechanic. Address R. J., AM. MACHINIST.

Wanted—A mechanical foreman, by a responsible manufacturing company in Conn., to take charge of their machine shop and brass department for the manufacture of steam and gas fitters' and steam users' supplies and tools; must be a good general mechanic of ability, with experience in these or similar lines, capable of designing tools for cheapening costs, and skilled in managing help. Address, stating particulars, Box 108, AMERICAN MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Just out; aluminum-steel hack-saws, hard but not brittle. Crescent Mfg. Co., Cleveland, O.

New catalogue of engineers' specialties free. Crescent Mfg. Co., Cleveland, O.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State st., N. Y., Consulting Engineer. Designs of all kinds of Machinery.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Model Engine Castings for sale. Send for circular Lowell Model Co., 170 Merrimack st., Lowell, Mass.

Koopman's Scales for quick and accurate measurements.

Complete list of our new tools for 2c. stamp. A. T. Koopman, Chicago.

Designs and working drawings for special machinery, tools, etc. attended to by experienced draftsman. "Draftsman," Box 107, AM. MACHINIST.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Lord & Co., P. O. Box 1262, Phila., Pa.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Wanted—To contract for the manufacture of a small article of sheet steel No. 22, requiring stamping out, fitting and nickel plating. Address Box 110, AMERICAN MACHINIST.

Established 1882. BRADLEY'S POWER HAMMERS
The BEST in the WORLD
RUN BY BELT.

BRADLEY'S HELVE HAMMER.
Over 1500 in USE

BRADLEY'S UPRIGHT HAMMER. BEAUDRY'S UPRIGHT HAMMER.
BRADLEY'S HEATING FORGES

BRADLEY'S HARD COAL HEATING FORGE.
Indispensable in all shops to keep BRADLEY'S CUSHIONED HAMMERS and men fully employed and reduce the cost of production.

BRADLEY'S SOFT COAL FORGE.
BRADLEY & CO. SYRACUSE, N.Y.
63 Murray st. NEW YORK; 98 Sudbury st. BOSTON, MASS

SOLID EMERY AND Triple Coated OIL STONES KNIFE SHARPENER
WHOLESALE ONLY BY THE TANITE CO., STROUDSBURG PA.

JONES & ROGERS,
5 West 4th St., Cincinnati, O.,
CONSULTING ENGINEERS
AND BLUE PRINTERS.
Machines Designed and Working Drawings Made.
We never sleep. WRITE FOR ESTIMATES.

C. B. JAMES, 98 Lake St., CHICAGO.
FINE TOOLS.

L. S. STARRETT,
Manufacturer of
FINE TOOLS,
ATHOL, MASS.
SEND STAMP FOR FULL LIST.

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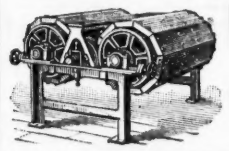
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ROPER'S PRACTICAL HANDY-BOOKS FOR ENGINEERS AND FIREMEN.
Each Work Fully Illustrated. By Stephen Roper, Engineer.
Written in plain, practical language, devoid of theories or mathematical formulæ.
Engineers' Handy-Book. The most comprehensive and best illustrated book ever published in this country on the Steam Engine, Stationary, Locomotive and Marine, and the Steam Engine Indicator. Price, $3.50.
Hand-Book of Land and Marine Engines. Price, $3.50.
Hand-Book of Modern Steam Fire Engines. It contains descriptions and illustrations of all the best types of Steam Fire Engines. Price, $3.50.
Hand-Book of the Locomotive. One of the most valuable treatises ever written on the subject, and contains a description of the most improved types of Locomotives in use. Price, $2.50.
Instructions and Suggestions for Engineers and Firemen. Price, $2.00.
Use and Abuse of the Steam Boiler. Price, $2.00.
Catechism of High Pressure Steam Engines. It contains a fund of valuable information for Engineers, expressed in plain, simple language. Price, $2.00.
Questions and Answers for Engineers. Contains all the Questions that an Engineer will be asked when undergoing an examination for the purpose of procuring a license. Price, $3.00.
Care and Management of the Steam Boiler. Of immense value to owners of Steam Boilers. Price, $2.00.
Young Engineer's Own Book. Containing an explanation of the Principle and Theories on which the Steam Engine as a Prime Mover is Based. With 106 illustrations, 363 pages. 18mo. Price, $3.00.
Any of the above works will be sent to any part of the United States or Canada on receipt of list price.
Send Money in Registered Letter, P. O. Order, or Postal Note. Descriptive Catalogues sent to any address, on application to EDWARD MEEKS, Publisher, 1012 Walnut St., Phila., Pa.

MACHINIST'S SCALES,
PATENT END GRADUATION.
We Invite Comparison for Accuracy with all others.
EVERY SCALE GUARANTEED. SEND FOR LIST.
COFFIN & LEICHTON, SYRACUSE, N. Y.

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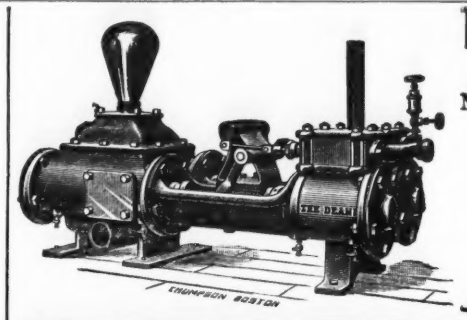
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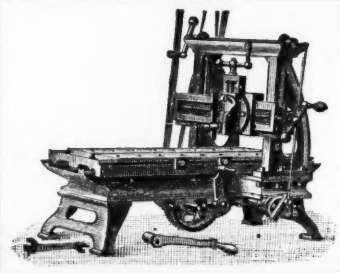
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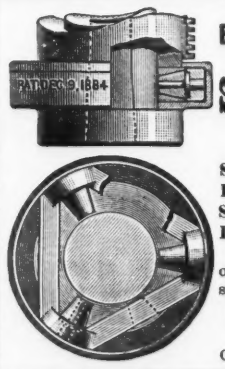
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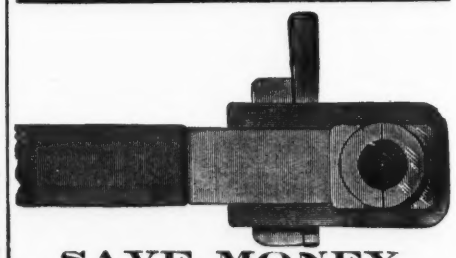
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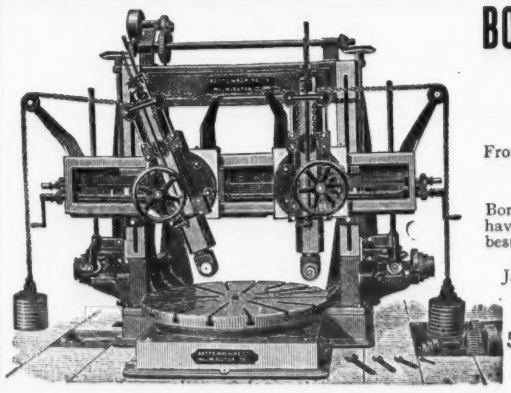
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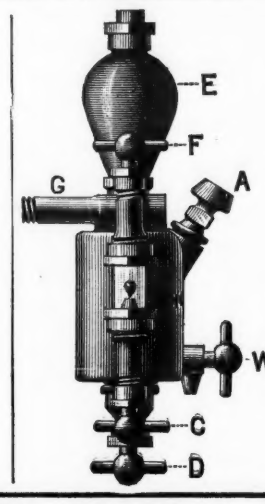

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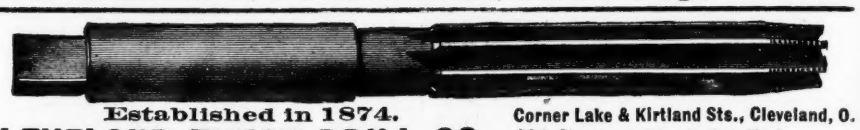

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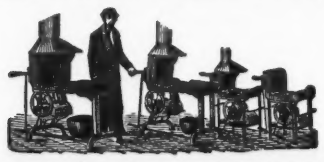

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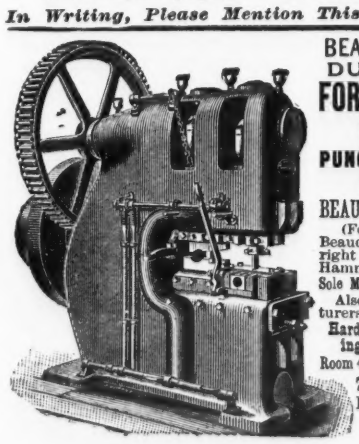

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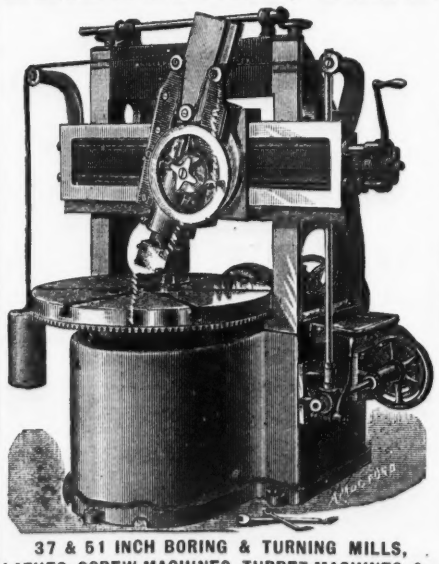

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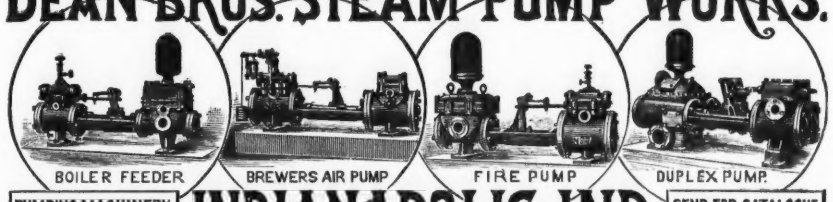

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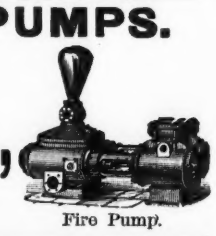

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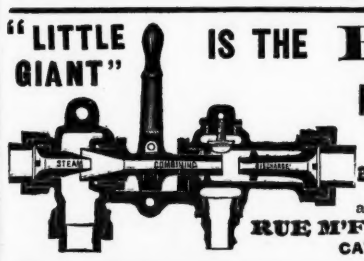

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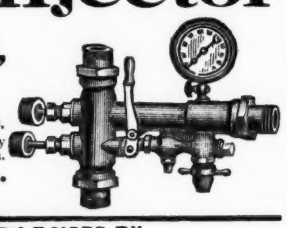

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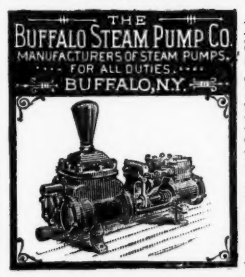

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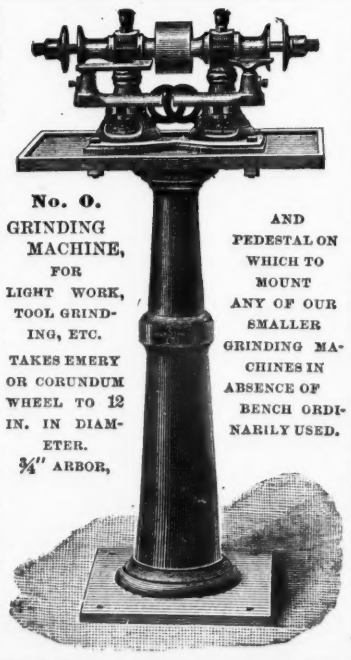

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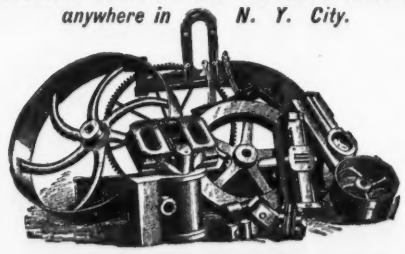

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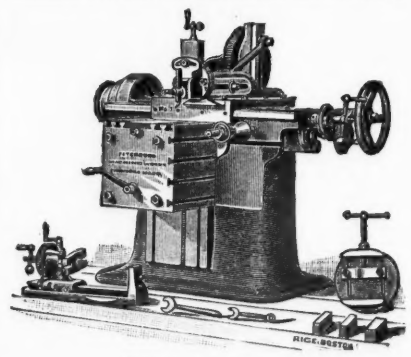

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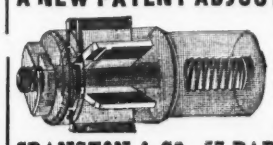

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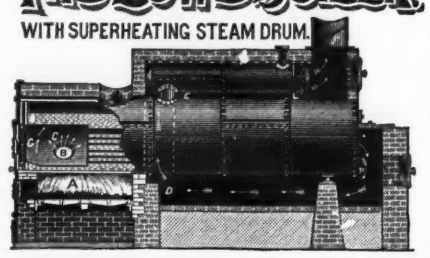

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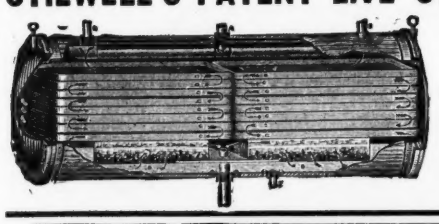

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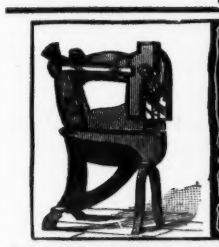

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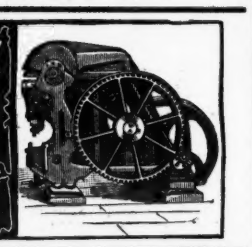

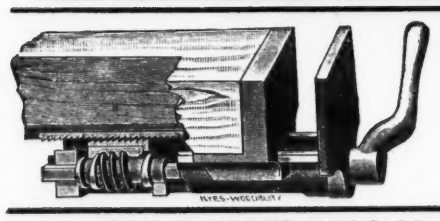

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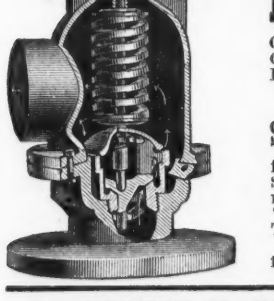

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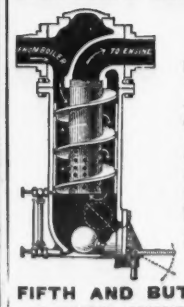

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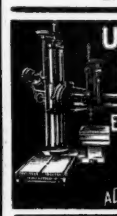

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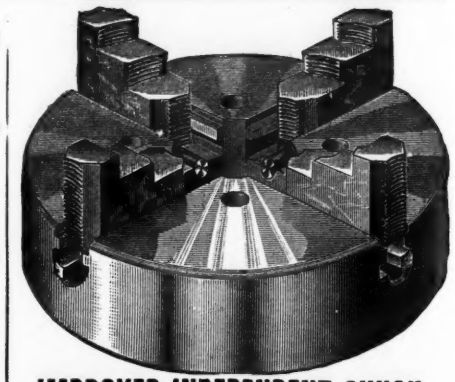

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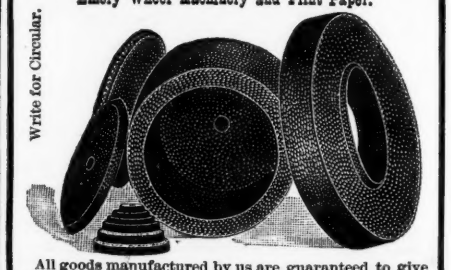

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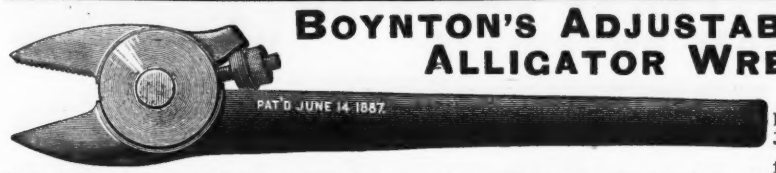

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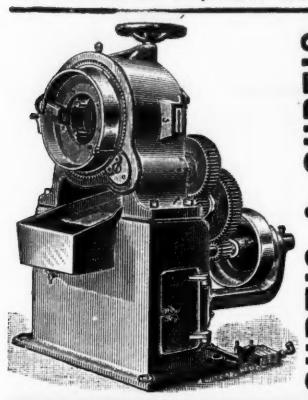

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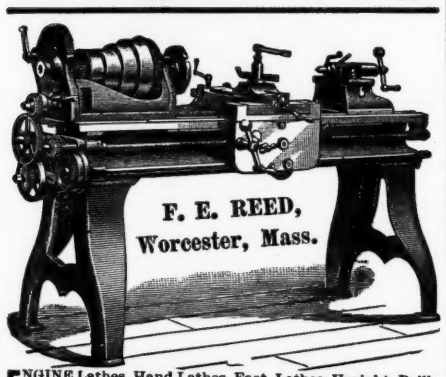

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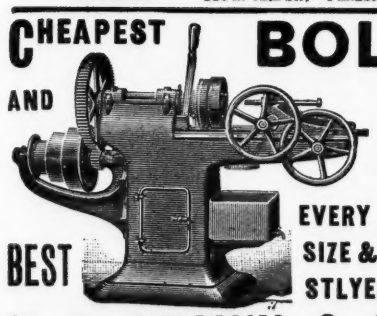

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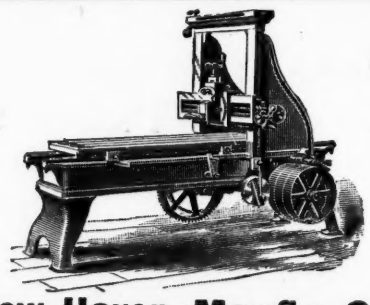

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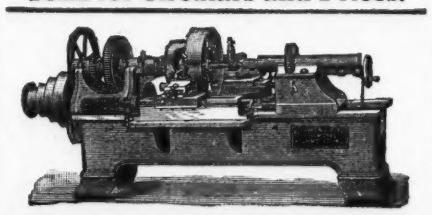

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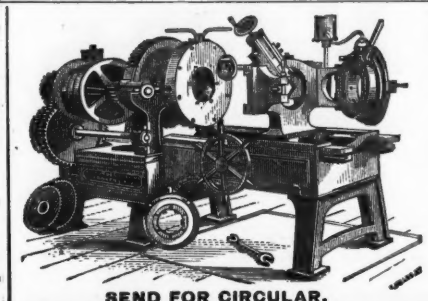

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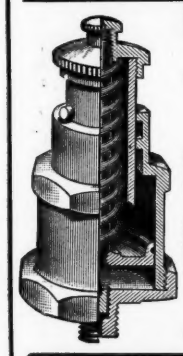

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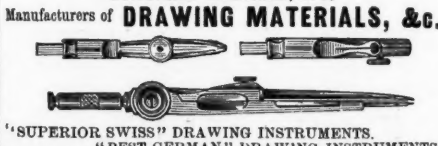

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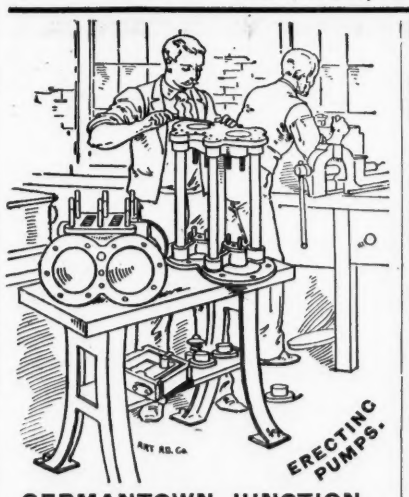

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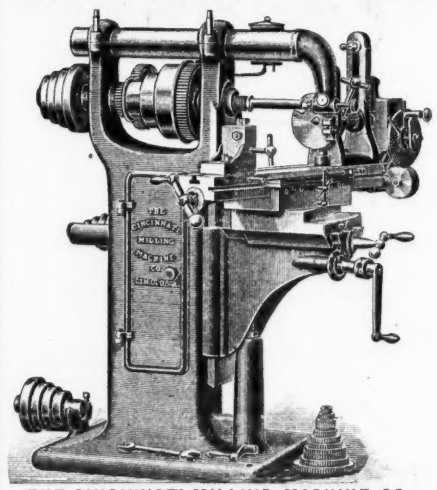

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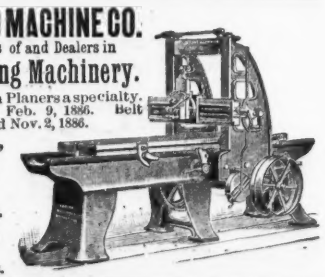

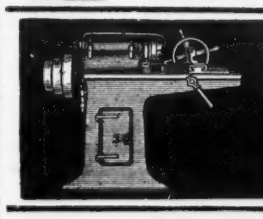

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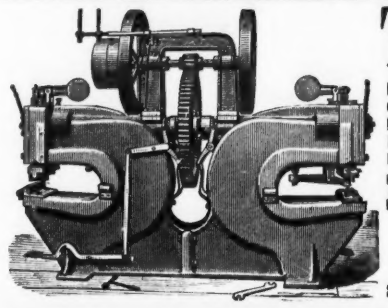

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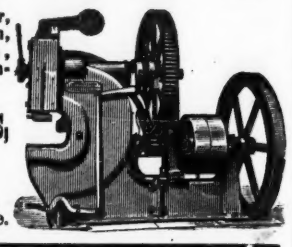

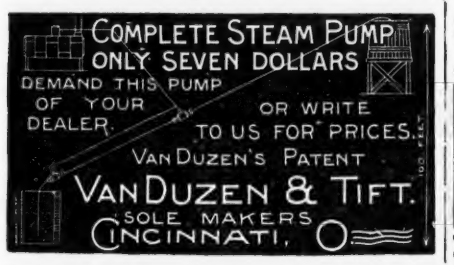

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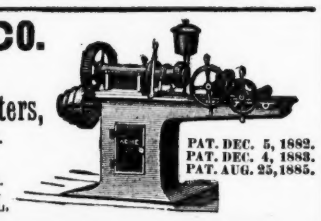

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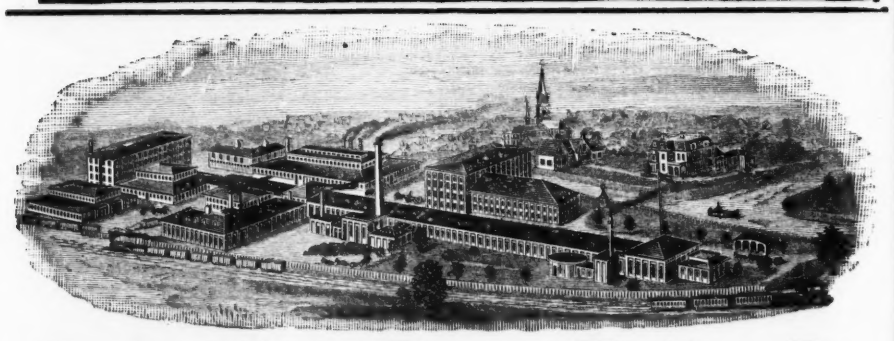

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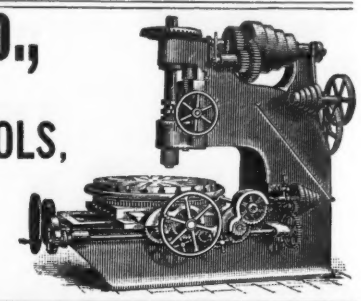

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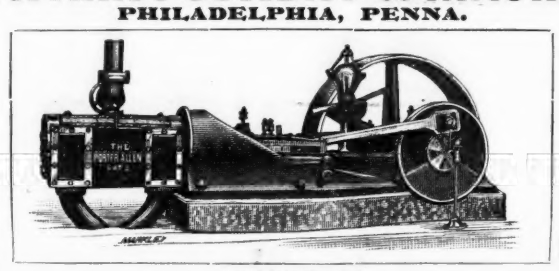

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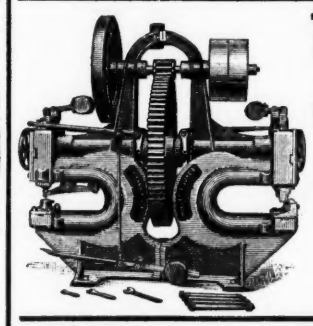

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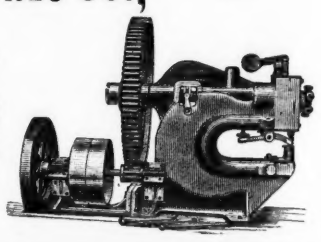

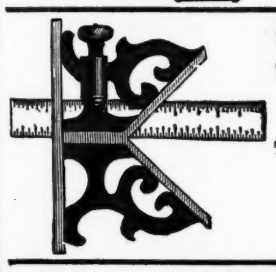

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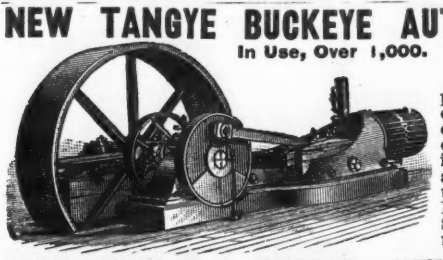

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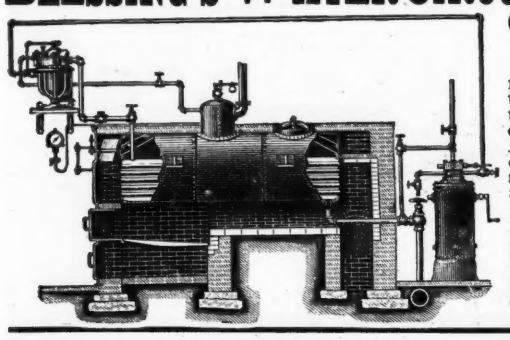

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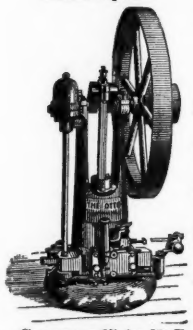

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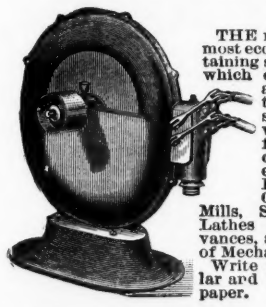

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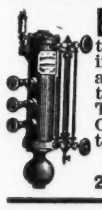

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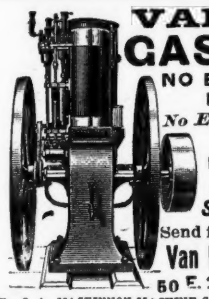

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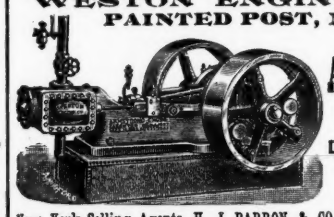

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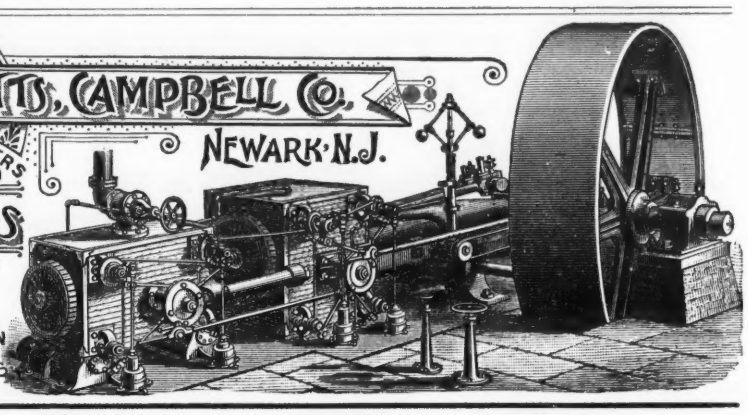

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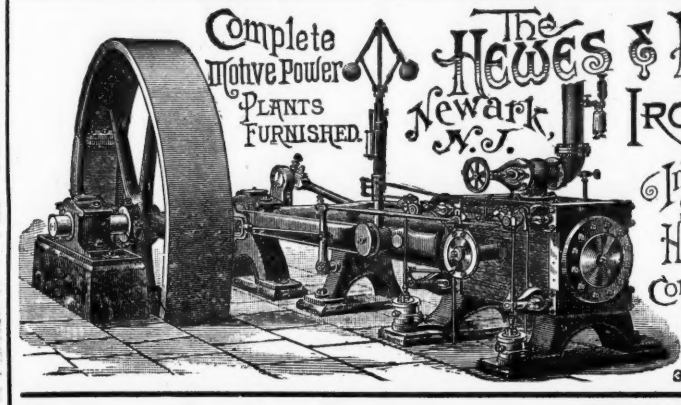

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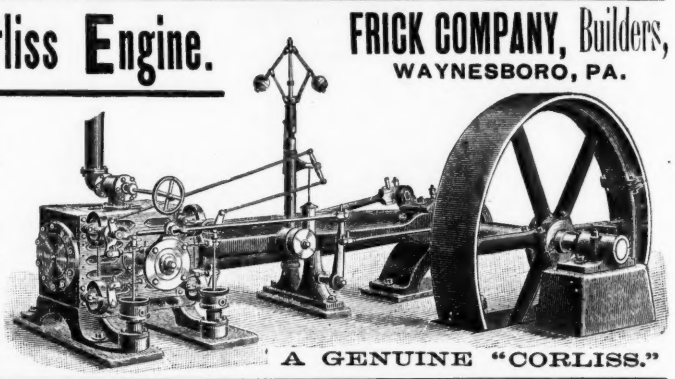

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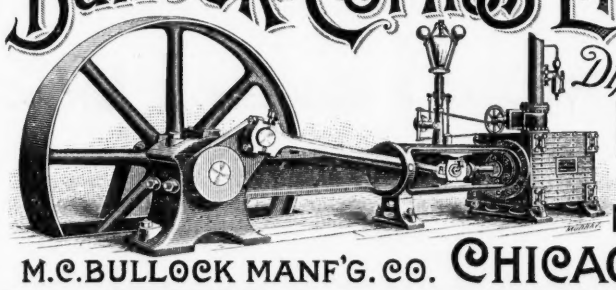

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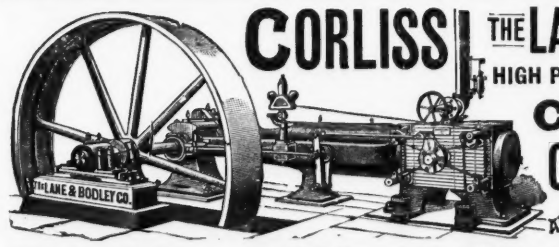

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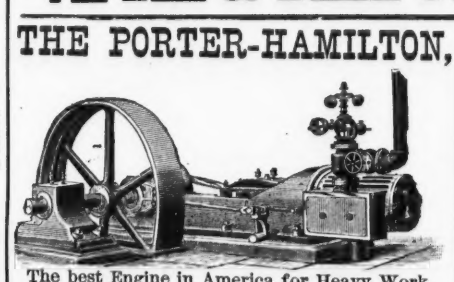

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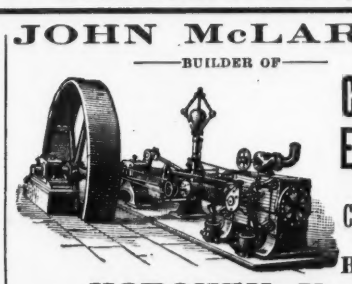

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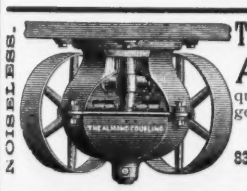

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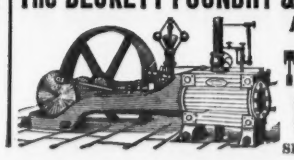

The "MUNZER" Corliss Engine.

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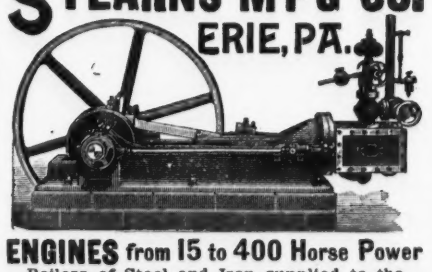
STEARNS M'F'G CO.

ERIE, PA.



ENGINES from 15 to 400 Horse Power

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogue.

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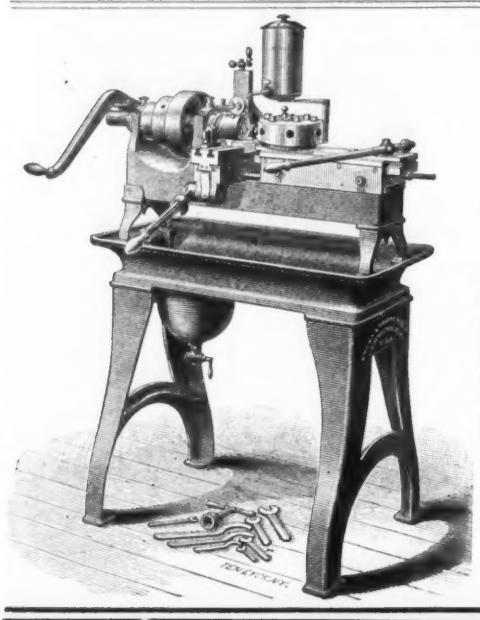

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IMPROVED SCREW MACHINE.

For Making Screws, Turning, Boring, and Facing Bushings, Tapping and Facing Nuts, Making Washers, Pins, &c.

In many instances this machine is used instead of an Engine Lathe, and effects a saving of 25% to 50% in the cost of the work.

The spindle boxes are steel, hardened and ground inside and out. The spindle is also steel: its front bearing is hardened and both bearings are ground. Size of hole through spindle, 21-32"; size of hole in revolving head, 13-16"; length that can be milled, 3½".

Illustrated Catalogue, showing full line of Screw Machines usually kept in stock, mailed on application.

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THE PRATT & WHITNEY CO.,

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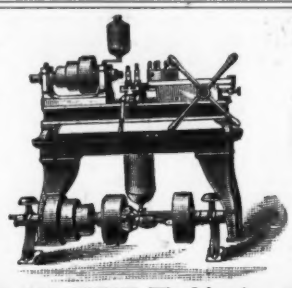
HORIZONTAL

Boring Mills,

48 in. and 66 in. Swing.



Double Head Traverse Drills

For ⅝ in., 3 in. and smaller holes.

Revolving Head Drilling Machines.

WESTERN BRANCH, 100 WEST Washington Street, Chicago, Ills.

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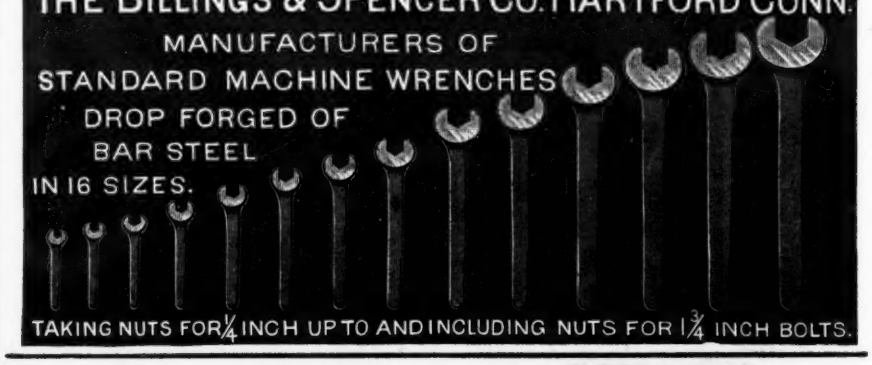
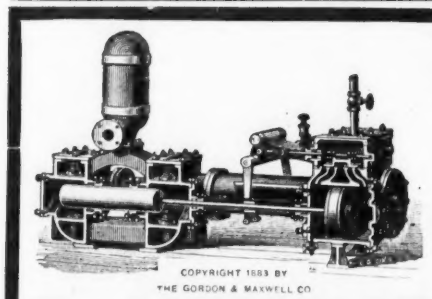
MANUFACTURERS OF STANDARD MACHINE WRENCHES DROP FORGED OF BAR STEEL IN 16 SIZES.



TAKING NUTS FOR ¼ INCH UP TO AND INCLUDING NUTS FOR 1¾ INCH BOLTS.



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PHILADELPHIA, 705 Arch Street.
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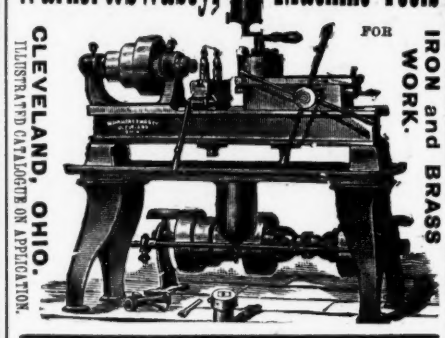
Warner & Swasey, Machine Tools

FOR IRON and BRASS WORK.



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Formerly of Worcester, Mass.

The new shops of this company are located at Plainfield, N J., forty minutes' ride from New York city on the line of the Central Railroad of N. J., and consist of the following:

A machine shop 500′ long by 100′ wide; a foundry 250′ long by 90′ wide; also commodious buildings for the storage of sand, coal, coke and pig iron; ample and convenient wash rooms for the men; fire-proof two-story pattern storage; blacksmith shop; engine and boiler houses. These buildings are detached from the machine shop and foundry. There is an elevated railroad for the convenient distribution of raw materials, and a railroad running through the machine shop for shipping. The whole plant is supplied with the incandescent system of electric lighting.

The machine shop and foundry have overhead traveling cranes running through their entire lengths; also light traveling cranes, which serve every tool, and a number of jib cranes in the foundry and scratch rooms. The foundry has capacity for making the heaviest class of castings.

All our tools are expressly designed for the economical manufacture of heavy machinery for railroad and general machine shop equipment, from new patterns of the latest and best designs.

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THE YALE & TOWNE MFG CO.
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JENKINS BROS.' VALVES.

Every valve tested and warranted, all parts interchangeable.
Nothing but best Steam Metal used in the manufacture.
JENKINS Key-eyed Stuffing Box and Disc Removing Lock Nut
Is used only in the Jenkins Bros.' Valves.
None are genuine unless stamped with "Trade Mark."
Should you order INSIST on having Jenkins Bros.' Valves.

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FROM 16 to 48 IN. SWING.

Cuts, Photographs and Prices furnished on application.

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Gear Wheels and Gear Cutting.—I make g to order, or cut teeth on g blanks sent to me. Of all kinds. Of all sizes to six ft. dm. Small orders or large ones. Fine g or cheap g. Small cast g. Ready made brass g by mail at low prices. Bevel g with perfect planed teeth. Hand Book on g, $1. Facilities complete. Terms reasonable. Send for cat
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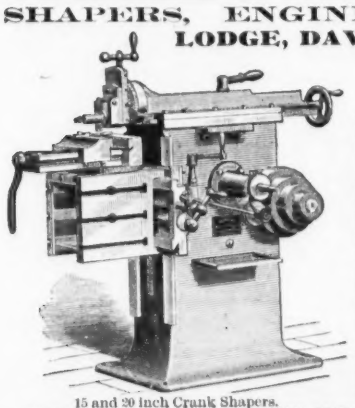

15 and 20 inch Crank Shapers.

WRITE FOR PRICES, IT WILL PAY YOU.

20 inch Upright Drills. 25 inch Back Geared, and
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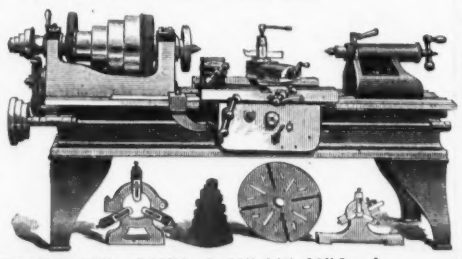

SHAPERS, 15″ and 20″ Crank, 20″, 26″, 32″ Geared.
ENGINE LATHES, 17″, 19″, 21″, 24″, 27″, and 38″.
(See advertisement, page 15.)

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Key-Seating Machines and 20 in. Drills

A SPECIALTY.

SEND FOR LIST OF

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Lathes, Planers, Drills, or anything in Machinists' Tools or Supplies.

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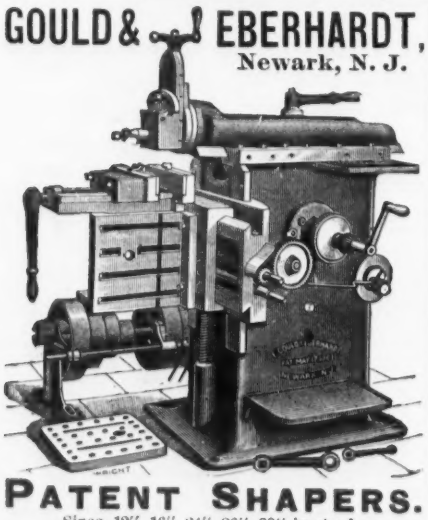

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Sizes, 12″, 16″, 24″, 26″, 30″ in stock.

GEAR AND RACK CUTTING TO ORDER.

E. E. GARVIN & CO.

LAIGHT & CANAL STS., NEW YORK,

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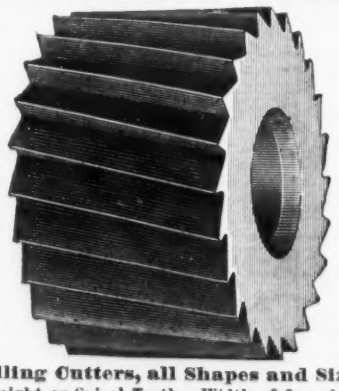

Milling Cutters, all Shapes and Sizes.

Straight or Spiral Teeth. Width of face, 1-8 in. to 3 in. Diameter, from 2 1-4 in. to 2 3-4 in.

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PRATT & LETCHWORTH,
PROPRIETORS
BUFFALO STEEL FOUNDRY,
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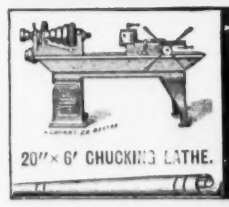

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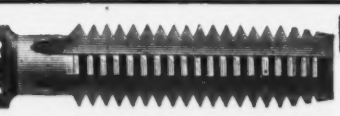

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